A Guide for PROSPECTORS in MANITOBA

1936

A
GUIDE FOR PROSPECTORS
IN
MANITOBA

Published by authority of the Hon. J. S. McDiarmid,
Minister of Mines and Natural Resources

Address all inquiries to
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FOREWORD

THE extension of activity in prospecting for mineral in the Province of Manitoba has emphasized the need for placing in the hands of the Prospector more detailed information of the geology of our extensive Precambrian areas.

In order to help him in his search for minerals, reports of all geological investigations made in the Province, many of which are now out of print, have been reviewed by the Mines Branch. The necessary information has been assembled in convenient and usable form. It is hoped that in collecting and condensing this material, the work of the Prospector will be greatly simplified.

In releasing "A Guide for Prospectors in Manitoba," the hope is expressed that it will be of practical help to the experienced prospector and a guide to those who have not yet experienced the thrill of original discovery. May they all share in that prosperity which the development of mining through their efforts is destined to bring to Manitoba.

June 1st, 1936

NOTE

This Guide has been prepared in the Mines Branch from material collected by A. J. McLaren, B.A., B.Sc., formerly Inspector of Mines and F. D. Shepherd, B.Sc., Inspector and Resident Engineer.

Many reports of the Geological Survey of Canada have been drawn upon freely, and much useful information has been obtained from reports made from time to time for the Province of Manitoba. The sources from which this information has been obtained are given at the end of each chapter on mineral areas.

GEO. E. COLE,
Director of Mines.

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INTRODUCTION

This publication, "A Guide for Prospectors in Manitoba," is designed to set forth general information which will serve as a guide to the numerous metalliferous areas in the Province.

Particular attention is paid to the location and size of and the means of access to the different areas, and, in addition, brief summaries of features which are of interest to prospectors are added for each area.

Information is given regarding the staking and recording of mineral claims. Together with this, some suggestions are made for the beginner as to necessary equipment and practice. Where it is desired to place emphasis on certain features in the text, italics or heavy type have been used.

The main purpose of the Guide is, however, to present the geologic features of the mineral areas. As it is difficult to render many of the geological terms in the simple English to which the miner was accustomed, a glossary is included which will serve to simplify the reading and make the terms more readily understood.

The publication will serve also as a catalogue of geological reports dealing with Manitoba. A bibliography of reports on each area is added following the description of the area. To these reports the reader is referred for a more detailed study of the geology and other features.

More than three-fifths of Manitoba is underlain by rocks of Precambrian age. This large territory, more difficult to travel and less hospitable than the plains country to the south, was for many years regarded only as a fur country capable of supporting a comparatively small number of trappers and the scattered posts of the great fur-trading companies.

In the late seventies of the 19th Century the Geological Survey of Canada commenced exploration of the western part of the Precambrian Shield, and during the next thirty years a few of its officers traversed a number of canoe routes and shore-lines in Manitoba and noted the various rock formations encountered. Meanwhile, the Lake of the Woods mining boom in western Ontario caused the prospecting of some small adjacent parts of Manitoba. The importance of the large Precambrian areas, however, was not recognized until the

great discoveries at Cobalt and Porcupine, early in the present century, aroused keen interest in the possibilities of the entire north country.

In 1911 gold-bearing quartz veins were discovered at Rice lake in the Central Manitoba area northeast of Winnipeg. This attracted the attention of prospectors trained in the Ontario camps and the great wave of prospecting then sweeping northern Ontario reached out into Manitoba as far north as the new line of the Hudson Bay railway where Tyrrell, Dowling, McInnes and other officers of the Geological Survey of Canada had reported favourable prospecting ground.

This movement of prospectors soon began to bear results, and gold was discovered at Herb lake in 1914 and the Flin Flon and Mandy deposits on Flinflon and Schist lakes, respectively, were discovered in 1915.

The next event of importance was the first production of metals from Manitoba ore in 1917. In that year the Mandy mine contributed copper, gold and silver from sulphide ores shipped to the smelter at Trail, B.C., and the Moosehorn claim at Herb Lake recorded the first production of gold from gold-quartz ores in a small shipment made to the same smelter. The Mandy ceased operations in 1920, and production for a number of years was confined to small outputs of gold by different operators working intermittently.

In 1924 and 1925 extensive development in the Central Manitoba, Herb Lake and Flinflon areas laid the foundation for the present production of metals, for at that time Central Manitoba Mines, Limited, Hudson Bay Mining and Smelting Company, Limited, and San Antonio Gold Mines, Limited, were amongst the companies that commenced work.

The rising prices of the base metals coincided with this development, causing an increase of prospecting activity that culminated in the staking and recording of 10,853 mineral claims in 1928. The collapse of metal prices early in 1929 brought this activity almost to a standstill, the low point being reached in 1930, but by 1931 interest in gold mining was renewed. It has continued to increase steadily under the stimulus of the unprecedented price for gold.

To the end of 1930 the mineral industry was more or less in an experimental stage, and the total production of metals up to that time from a number of properties working periodically

was only $4,155,843. Since 1930, however, production has exceeded $7,000,000 annually from three mines working continuously. The result is an industry firmly established in prosperous communities and attracting an ever-widening public interest.

With an improved outlook for the base metal producers, a corresponding increase in prospecting activity may be expected. Prospectors have already discovered hundreds of mineral occurrences in the various known areas of the Province. Some of these will become mines. Their further exploration probably lies mainly with the developing mining companies.

A close observation of prospecting in the Province over a number of years and a review of the many excellent geological reports of Alcock, Bruce, Wright, and others, *would indicate that apart from one or two localized areas the greater part of the known mineral areas has been incompletely prospected, leaving large areas practically unexplored.*

The discoveries made in many of the older gold areas of the Precambrian in recent years *testify to the wisdom of careful and skilled work, so that more detailed prospecting than has hitherto been done in these mineral areas is necessary.*

PART I

EQUIPMENT FOR PROSPECTORS

A few suggestions can be made to the man who is considering a prospecting trip and who has had little bush experience. If he plans to finance his own venture, and has not had much training, he would do well to secure a competent companion or to enlist the services of another like himself and confine his activity to areas that are fairly well marked by trail.

Various arrangements may be made as to financing a prospecting trip. Some men prefer to assume entire charge themselves. Others work on a "grubstake," that is, all expenses paid for them in addition to a substantial interest in any discovery they may make. Other prospectors having considerable experience are employed by some of the larger mining companies who are ever on the lookout for new properties.

The following excellent list of necessary equipment has been recommended by the Ontario Department of Mines for the use of prospectors and, with the exception of personal equipment, should adequately outfit two men for much of a season, exclusive of staking charges on any discoveries made:

TRAVELLING EQUIPMENT

Canoe, 17′ Prospector model, used $30.00; new	$75.00
Tin of Jeffrey's marine glue for patching	.60
One tent, 7 by 9 feet, with wall (this should be silk if possible, thereby saving weight). Cotton duck, $15.00; silk	48.00
One canvas tarpaulin for tent floor	8.00
Three pairs of heavy woollen blankets	25.00
Two mosquito bars	6.00
Two pack sacks	12.00
Two pack sheets with tump lines	5.00
Fly oil (citronella mixture or oil of pine needles)	1.00
Fly Tox	1.00
Total	$181.60

Cooking Utensils

Two frying pans	$ 3.00
Nest of pails	6.00
Stirring spoon and fork	.50
One butcher knife	1.50
Four tin plates	.20
Four pannikins (tin cups without handles)	.60
Three each of knives, forks, teaspoons, and tablespoons	1.00
Dish towels, two yards	.50
Fishing lines, trolls, etc.	2.00
Flashlight, extra cells and bulbs	2.00
First-aid kit, bandages, compresses, iodine, etc.	1.50
Total	$18.80

At the Portage — A pause in the life of the Prospector
On the Echimamish river.

TOOLS

Two light camp axes, 2½ lbs.	$ 3.00
One bricklayer's hammer	1.50
One long-handled grub hoe and hammer	1.50
Mortar and pestle, and sieve	3.00
Gold pan	3.00
Small moil	.50
Geological maps "mounted," notebook, pencils	.50
Prospector's handbook and box of mineral samples.	
Total	$13.00

Hammer, 3 lengths of drill steel and dynamite, fuse and caps, if necessary, later on.

PROVISIONS FOR TWO MEN FOR ONE MONTH

50 lb. flour	2 lb. coffee or cocoa
40 lb. bacon and pork (long clear)	1 lb. baking powder
6 lb. butter	3 lb. dried apples
6 lb. beans	3 lb. dried peaches
4 lb. rice	3 lb. dried prunes
2 lb. raisins	3 lb. dried apricots
3 lb. cornmeal	30 lb. sugar
6 lb. rolled oats	1 doz. soup tablets
3½ lb. bag of salt	1 doz. Oxo cubes
1 can pepper	1 lb. pot barley
2 doz. candles (short)	1 lb. split peas
½ gal. or 10-lb. tin of corn syrup	2 tins dessicated potatoes
2 lb. tea	30 small cans evaporated cream, or equivalent of powdered milk
	Abundant supply of matches.

The weight of the above would be approximately 200 pounds, and the cost, depending on locality, from $25.00 to $30.00. Outfitters in the north will put these supplies in cotton bags of various sizes with tie strings attached—a necessary convenience for packing. Paper bags are useless.

PERSONAL EQUIPMENT

Each man should carry his own watch, compass, waterproof match box, magnifying glass and hunting knife	$5.00

Clothing should be cut to the minimum in order to save space and weight. The following per man will be ample for a summer's work:—

Heavy khaki shirt and pants	$ 5.00
Extra shirt	2.00
One light sweater coat, woollen	3.00
3 pair woollen socks	1.50
2 suits woollen underwear	6.00
Hobnailed boots	8.00
Light canvas shoes for camp	1.50
Towel and soap, razor, metal mirror	2.00
Total	$29.00

The total cost of the above items is $277. The sum of $300 apart from rail or motoring costs would, therefore, see two men, outfitted completely and on the trail, bound for some likely prospecting ground. In the event of staking a group of claims, however, there will be the added expenses of railway transportation, recording fees, and incidental living expenses.

Two men planning to spend a season at prospecting, say from May 15 to October 1, should be financed to the extent of $1,000 at least. This is exclusive of wages.

Axes and Prospecting Picks.—These are important; the axe and matches in the last analysis are the two most important articles a prospector carries, and they have meant life to many a man in the bush. The axe should weigh around 2½ pounds with a 27-inch handle of hickory, hung at such an angle that it cuts on the stroke. There are two kinds of picks: the short-handled geologist's pick, and the long-handled instrument with a pick end to remove moss and a hammer to break off samples. Prospectors in Manitoba favour the long pick, and also often carry a small belt axe for blazing trees, etc. Some prefer a bricklayer's hammer to a small prospecting pick. A water-tight match holder is necessary.

The Compass.—In the field the prospector should learn to rely upon his compass and from time to time check his readings on the sun, particularly if he happens to be in an area in which he suspects "local attraction." Mineral zones sometimes cause marked deflections in the direction of a compass needle. He should learn to travel as far as possible from established water courses, at the same time keeping a close check on his position. This is not only important for safety's sake but should a discovery be made, the exact location is desirable for the preparation of his claim sketches.

Sampling.—If he is fortunate enough to make a discovery of a quartz-vein bearing minerals, he should be exceptionally diligent in sampling this occurrence. The samples should be cut at intervals across the vein as closely spaced as possible. Each sample should be cut at right angles to the vein wall for a width of at least 2 inches and an inch in depth. This is done by chipping the vein material on to a canvas sheet by means of a moil struck with a hammer weighing approximately 3 pounds. Well-taken samples are worth the trouble spent on them. It is much more easy to get interest shown in a property that has a few good channel samples than in one from which only grab samples have been taken.

Further exploratory work on a mineral occurrence should be done under the direction of someone thoroughly experienced in that type of work. Misdirected work of this type is very

expensive, and it is of utmost importance to have the property well prepared for examination by mining scouts, geologists or engineers.

FOREST FIRE PROTECTION

Every precaution should be taken while travelling in the northern woods, especially during the hot summer months, to protect the forests from fire. Remember your own life and the lives of others may depend on the care you exercise in this respect.

The forests of Manitoba belong to the people of Manitoba; protect them for your own use and the use and enjoyment of others. Remember timber will be necessary in mining operations.

Do not build your camp fire in a dry, mossy place or against dry stumps or logs. Select a spot on which there is the smallest quantity of combustible material and from which there is the least likelihood of the fire spreading. Remove all dead trees, branches or vegetable matter within a radius of ten feet of the fire, and use all reasonable precautions to prevent such fire spreading.

Do not forget to see that your fire is absolutely out before leaving camp. Use lots of water or cover it with sand or clay. Anyone leaving a camp fire burning is liable to a maximum fine of one hundred dollars or six months' imprisonment.

Any Forest Ranger or Fire Ranger may call out any male citizen to assist in fighting forest fires. Fire signs or Forest Service property must not be interfered with. Persons while travelling through the woods, when requested to do so by a forest officer must give information as to their name, address, movements, etc.

The Manitoba Forest Service will assist you in every way possible with information that may help you in your work, and we ask for your co-operation in preventing the destruction of the forests.

PREVENT FOREST FIRES—IT PAYS

STAKING AND RECORDING OF MINERAL CLAIMS

With the transfer of the natural resources to the Province of Manitoba, a Mines Act was passed by the Legislature in 1930 and regulations for the disposal of mineral claims were adopted under the provisions of this Act. Generally speaking, the Regulations follow in principle the Quartz Mining Regulations as in force at April 1, 1929, under the Mineral Lands Administration, Department of Interior.

For full information regarding the manner in which mineral claims may be taken up and held, reference must be made to the regulations under the Mines Act for the disposal of mineral claims. For the convenience of those interested, a brief summary of the regulations is given.

Who May Prospect

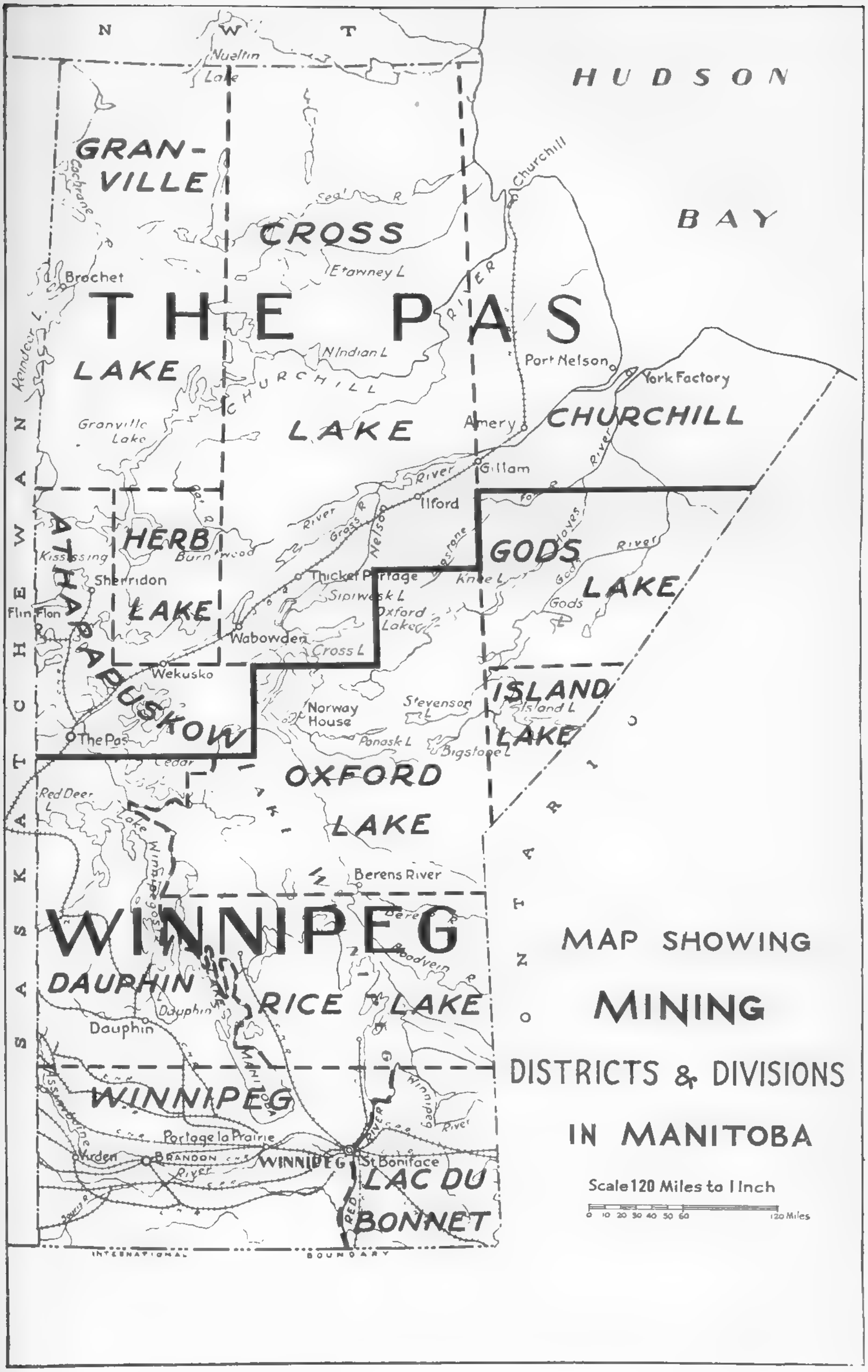
Every person of the age of eighteen years or over who has obtained a miner's license is entitled to prospect for minerals on vacant Crown lands of Manitoba. Miner's licenses are obtainable at the Mining Recorder's offices, Winnipeg and The Pas, Manitoba. The fee for a license is $5.00. A license expires at midnight on the thirty-first of August. Licenses are not transferable.

Mining Districts and Divisions

The Province is divided into two Mining Districts:

(1) *The Winnipeg Mining District* includes southern Manitoba and all the country east of and tributary to Lake Winnipeg. The farthest north prospecting areas in this district are Knee, Oxford, Gods and Island Lakes. Claims staked in the district must be recorded at the Mining Recorder's office, Winnipeg.

(2) *The Pas Mining District* comprises all northern Manitoba north of the Hudson Bay railway and a fringe south of the railway and tributary to it, such as Cross Lake, the Fox River and the lower Nelson River areas. Claims staked in the district must be recorded at the Mining Recorder's office, The Pas.



MAP SHOWING
MINING
DISTRICTS & DIVISIONS
IN MANITOBA
Scale 120 Miles to 1 Inch
HUDSON BAY
N W T
THE PAS
GRANVILLE LAKE
CROSS LAKE
HERB LAKE
ATHAPAPUSKOW
CHURCHILL
GODS LAKE
ISLAND LAKE
OXFORD LAKE
WINNIPEG
DAUPHIN
RICE LAKE
WINNIPEG
LAC DU BONNET
SASKATCHEWAN
ONTARIO
INTERNATIONAL BOUNDARY
Brochet
Port Nelson
York Factory
Amery
Gillam
Ilford
Thicket Portage
Sherridon
Flin Flon
Wabowden
Wekusko
The Pas
Norway House
Berens River
Dauphin
Portage la Prairie
Brandon
Virden
Winnipeg
St Boniface
Churchill

Number of Claims That May Be Staked

Each mining district is divided into a number of divisions and a licensee may, in any one license year or in any one mining division, stake out and apply for:

(a) Not more than three mineral claims on his own license;

(b) Not more than six claims for other licensees, being a maximum of nine claims in all, provided that not more than three claims shall be staked out or applied for on behalf of any such other licensee. See section 20.

For particulars as to lands not open for staking, such as Indian Reserves, Dominion Parks, townsites, etc., see sections 11 and 12. For application of Forest Act to mineral claims see sections 13 and 14.

Staking of Claims

A mineral claim in unorganized territory is 1,500 feet square with boundary lines running as nearly as possible north and south and east and west astronomically; see section 18. In staking, a post is placed at each corner of the claim and the boundary lines are brushed out. Trees on the lines are blazed on two sides only.

The diagrams shown in Figures 1–8 and the Sketch Plans are intended to illustrate sections 21–25, and 30 of the regulations (See pages 10 to 13). They give in detail the information required on each of the posts as well as showing how the post is made, planted and mounded. The Sketch Plans show how a claim is staked on the shore of a body of water and its relation to other claims staked on land adjoining.

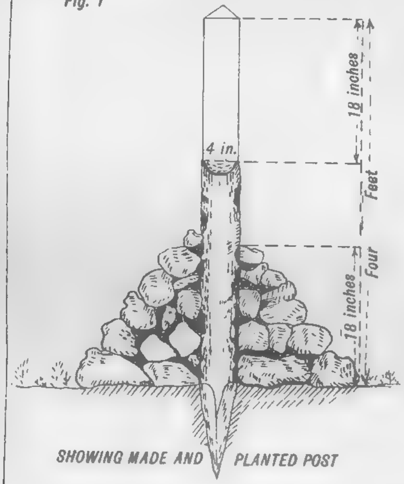
Recording of Staking

If a claim is staked within ten miles of the office of the Mining Recorder for that district, it must be recorded within fifteen days. For every additional ten miles' distance one additional day is allowed for filing application to record. See section 34.

Metal tags obtained from the Mining Recorder, showing the recorded number of the claim, are required to be affixed to all of the corner posts after recording. See section 38.

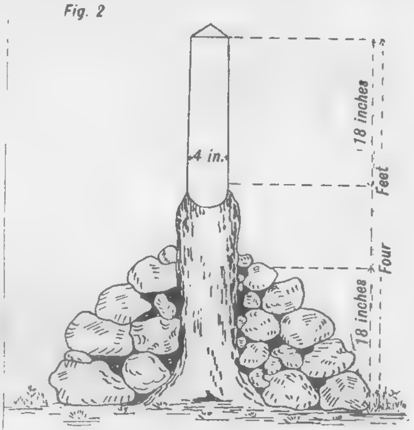
Fees for recording mineral claims are $5.00 per claim where the licensee stakes the claim himself; $10.00 per claim where the licensee stakes on behalf of another licensee.

Fig. 1



SHOWING MADE AND PLANTED POST

Fig. 2



SHOWING STUMP OF TREE MADE INTO POST

Fig. 3

SKETCH OF POST AND MOUND SHOWING MARKING ON LOCATION POST No. 1 OF MINTO CLAIM STAKED BY B. J. BOX, OWNER OF LICENSE No 23, AT 3.15 P.M., AUG. 10, 1929.

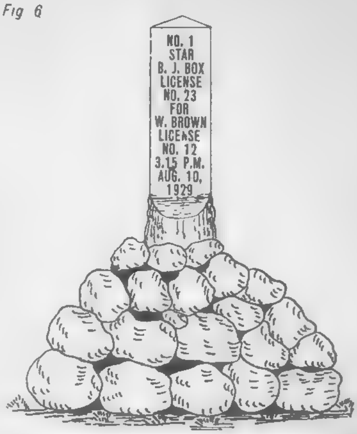
Fig. 4

SKETCH OF POST AND MOUND SHOWING MARKING ON LOCATION POST No. 2 OF MINTO CLAIM-STAKED BY B. J. BOX,

Fig. 5

SKETCH OF POST AND MOUND SHOWING MARKING ON WITNESS POST No. 3 OF MINTO CLAIM STAKED BY B. J. BOX.

Fig 6

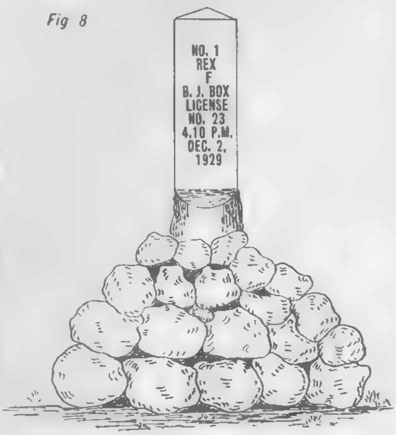


SKETCH OF POST AND MOUND SHOWING MARKING ON LOCATION POST No. 1 OF STAR CLAIM STAKED BY B. J. BOX, OWNER OF LICENSE No 23, ON BEHALF OF W. BROWN, OWNER OF LICENSE No. 12, AT 3.15 P.M., AUG. 10, 1929.

Fig. 7

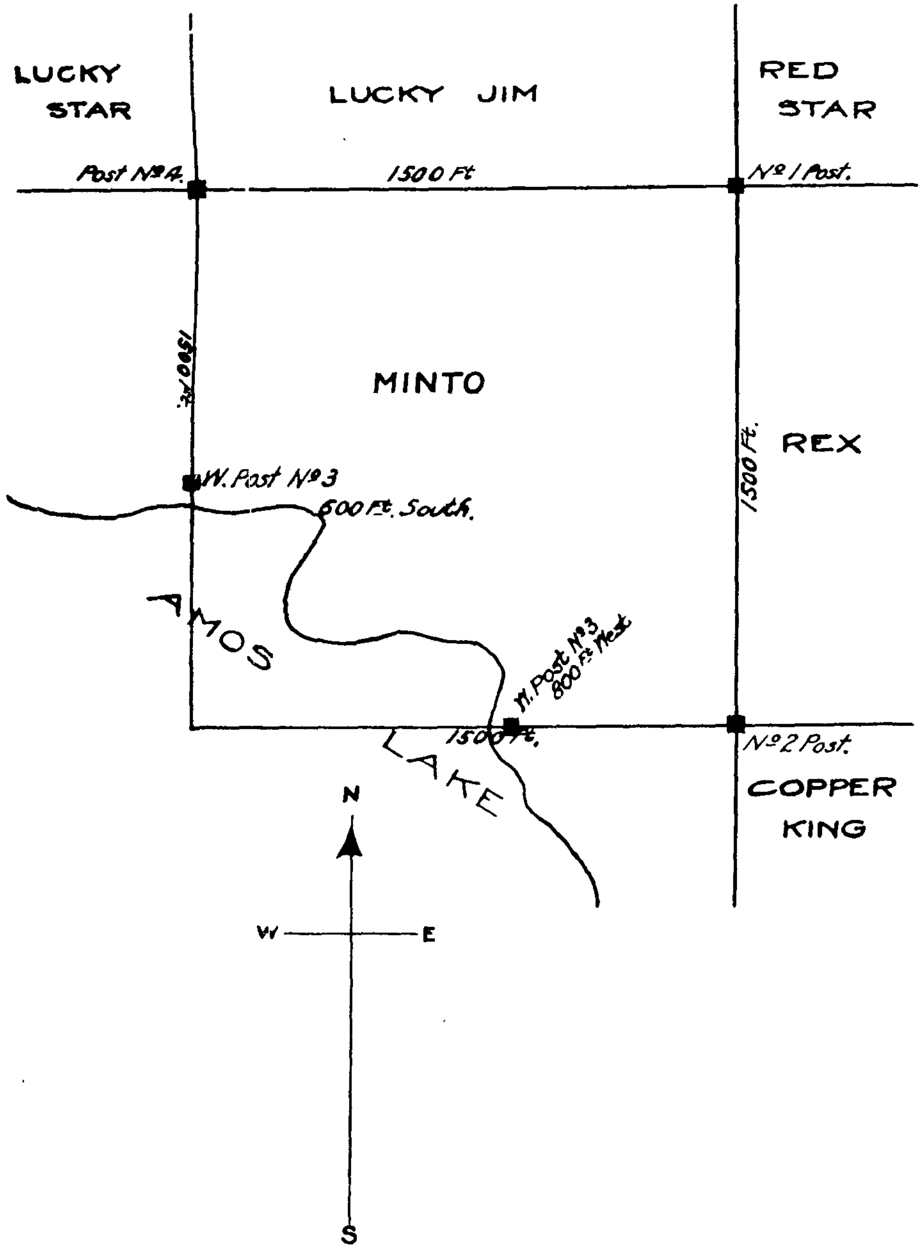
SKETCH OF POST AND MOUND SHOWING MARKING ON LOCATION POST No. 2 OF STAR CLAIM STAKED BY B. J. BOX, ON BEHALF OF W. BROWN

Fig 8

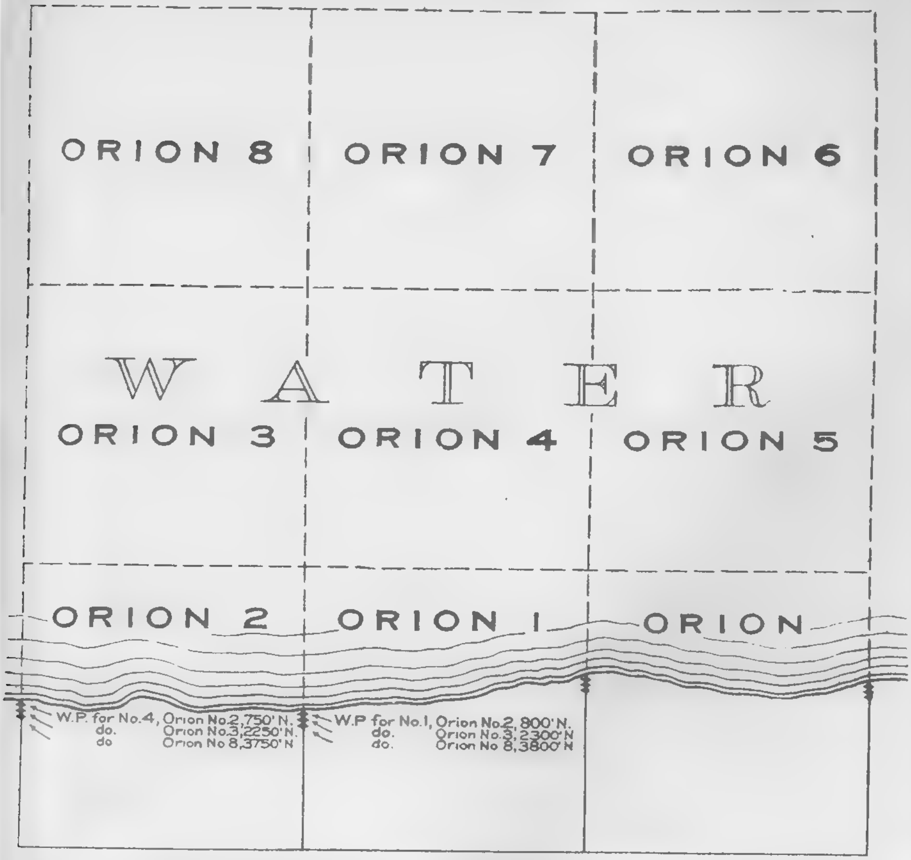


SKETCH OF POST AND MOUND SHOWING MARKING ON LOCATION POST No. 1 OF REX FRACTION STAKED BY B. J. BOX, OWNER OF LICENSE No. 23, AT 4.10 p.m., DEC. 2. 1929.

SKETCH PLAN OF MINTO CLAIM



METHOD OF STAKING WATER CLAIMS



Note: Northerly Posts only are necessary for claims staked northerly as shown
When staking claims southerly Posts 2 and 3 will be witnessed.
When staking claims easterly Posts 1 and 2 will be witnessed.
When staking claims westerly Posts 3 and 4 will be witnessed.

MINES BRANCH,
DEPT OF MINES & NATURAL RESOURCES
1933.

Representation (Assessment) Work

Claims are held from year to year by the performance of twenty-five days' work of eight hours each. However, if the area of a mineral claim, staked as a fractional claim, is less than twenty-five acres, the work required to be done each year in mining operations is one-half that required under the regulations in respect of a full claim. See section 51.

An affidavit containing a detailed statement of the work performed must be furnished to the Mining Recorder for the district in which the claim is situated, within one month after the year, in which the work must be performed, expires; otherwise the claim is allowed to lapse and after a stated time is cancelled and the ground thrown open for restaking. See sections 53, 54 and 55.

Claims up to nine in number may be grouped so that the annual work for the nine may be performed on any one or more of the claims. See section 49.

Purpose of Regulations

It is intended, as far as possible, to protect the honest prospector who complies substantially with the requirements of the regulations, from being defeated of any just claim by technicality, but a prospector should always endeavour, if he desires to avoid trouble and possibility of loss, to follow the regulations as carefully and as accurately as possible.

As it has been the intention to limit this Guide to prospecting, such questions as the obtaining of a lease to a mineral claim, surface rights compensation, transfer of a mineral claim, etc., have been omitted from these notes.

Regulations governing these items in detail, maps, blank forms, and other general information can be obtained from J. G. Webber, Chief Mining Recorder, Mines Branch, Winnipeg, or W. B. McLellan, Mining Recorder, The Pas.

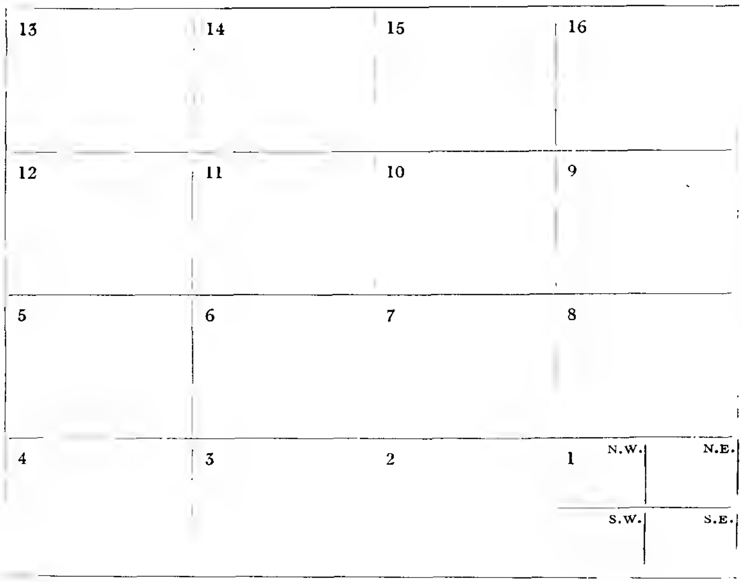
MAPS FOR PROSPECTORS

The Surveys Branch of the Department of Mines and Natural Resources prepares blue-prints of mineral claim locations in Manitoba for the use of prospectors. These blue-prints are kept up-to-date and assist the prospector in locating ground open for staking and also serve as a guide to his operations in the field. In their preparation a direct relationship is maintained to the National Topographic series of maps compiled by the Topographical Survey of Canada from aerial photographs. These are frequently referred to as "aerial" or "topographic maps."

The following is a description of the method used in outlining the limits of one of the "topographic maps." If the prospector understands the manner in which the boundaries of this map are determined and the relationship between the "claim map" and the "topographic map" he will be able at any time to write in a request to the Mining Recorder's office either at Winnipeg or The Pas for a mineral claim map by its correct designation.

The National Topographic series of maps is compiled mostly from aerial photographs on a scale of 4 miles to one inch. Each map embraces the area contained between consecutive latitude circles one degree apart (north and south) and between meridians of longitude of even number, i.e., two degrees apart (east and west). Each map covers an area of approximately 80 miles east and west by 68 miles north and south.

In the compilation of the blue-prints of mineral claims, the area shown is one sixty-fourth of that embraced by a topographic map, and the subdivision of the topographic map is made as follows. Each map of the National Topographic series is divided into sixteen rectangles (see sketch on following page), numbered in the southern row, from right to left, from 1 to 4; in the second row from left to right from 5 to 8 and so forth up to 16. Each of these rectangles is in turn subdivided into quarters, designated S.E., S.W., N.W., N.E. The mineral claim map that is numbered S.W.-4-52-M thus indicates the southwest quarter of rectangle 4 of the National Topographic map No. 52 M.

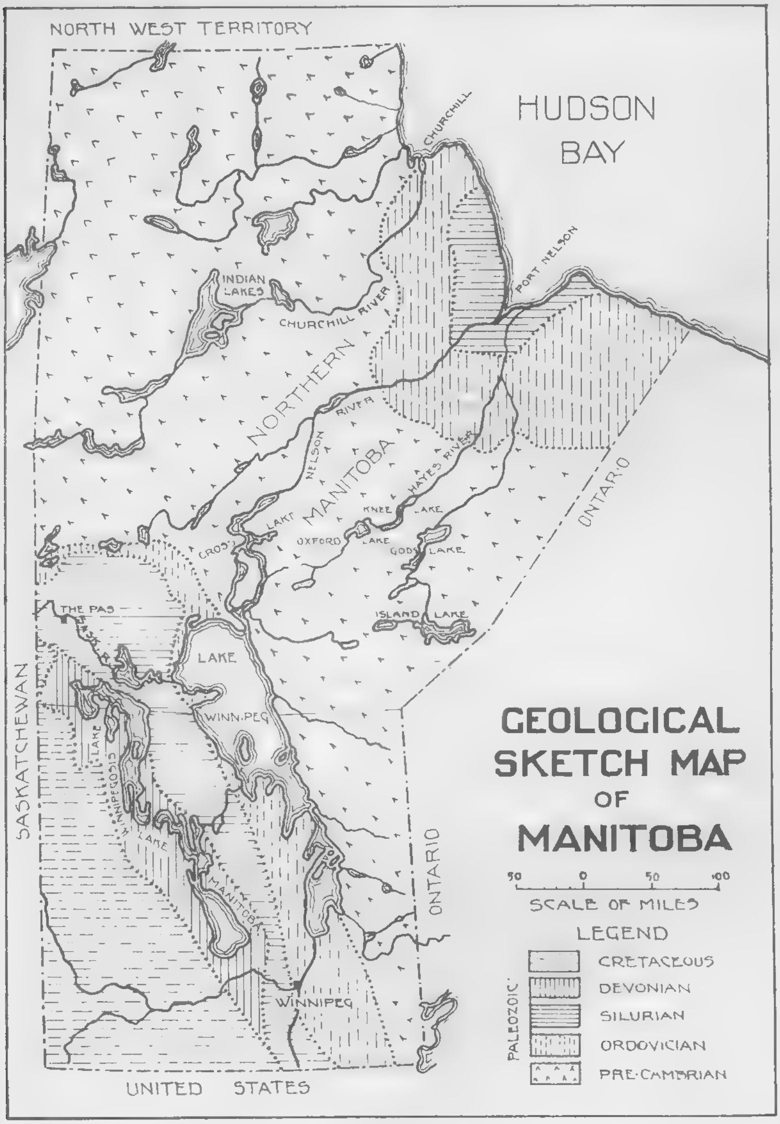


From the above sketch it may be seen that the area ot the claim map showing the mineral claims in the southeast quarter of rectangle 1 is one sixty-fourth of the area of the topographic map whose size is represented by the sum of all the rectangles. It will be seen that the scale of the mineral claim blue-prints is one-eighth of that employed on the National Topographic series of maps.

PART II

GEOLOGY OF MANITOBA

The area of the Province of Manitoba is 251,832 square miles. In this vast expanse of territory considerable differences in the nature and topography of the land surface occur. The south and southwestern parts are physiographically the eastern extension of the Great Plains region, characterized by deep soil cover and much open prairie and agricultural land.



To the east, northeast and north the so-called Plains country merges imperceptibly, rarely abruptly, into what is known variously as the Laurentian Plateau, the Precambrian Shield and the Canadian Shield, part of a vast région which surrounds Hudson Bay and differs from the plains to the west in showing a generally rougher surface, numerous glaciated outcrops of ancient rocks, and innumerable depressions occupied by lakes and muskeg.

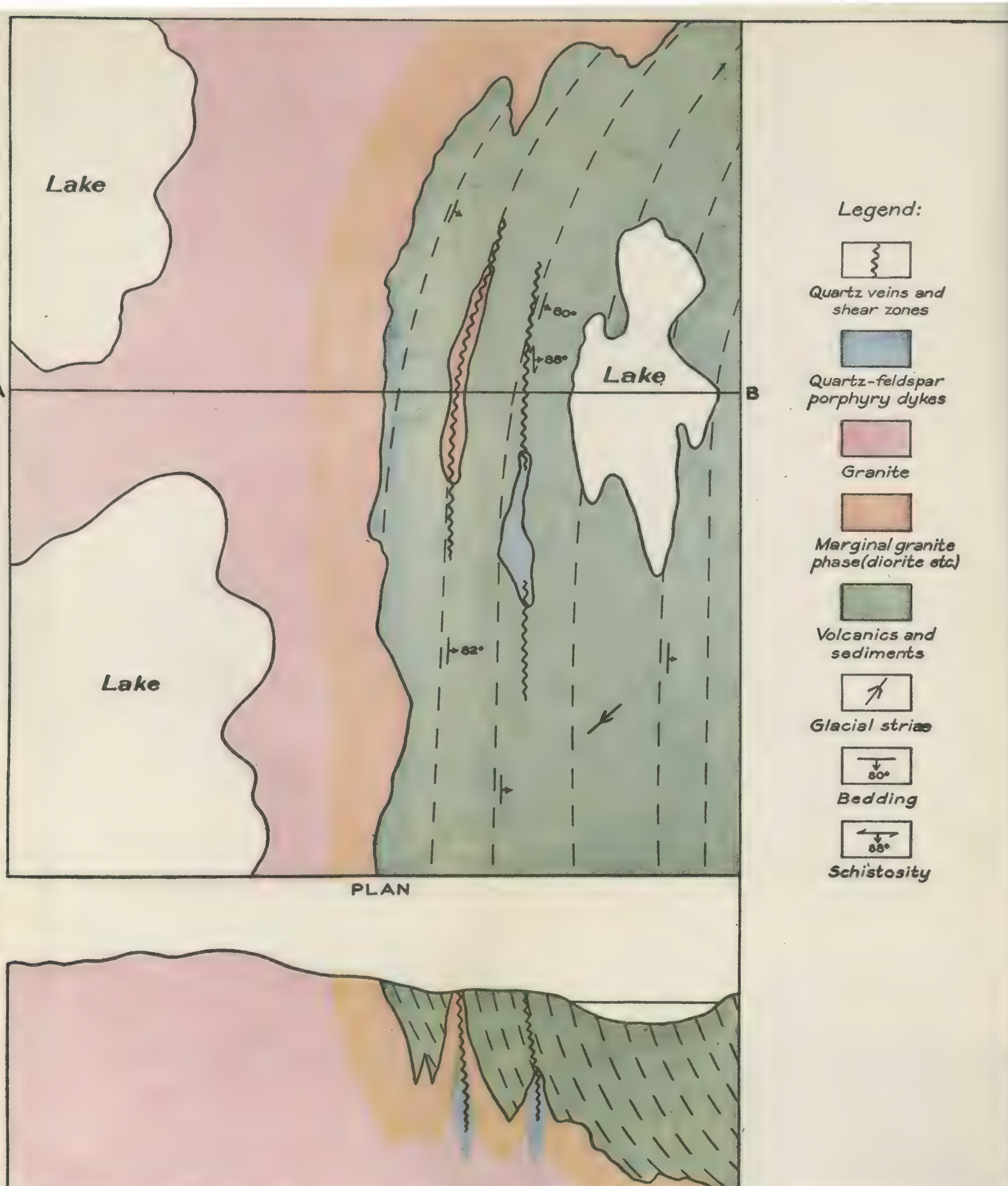
Another area, the Hudson Bay slope, for a considerable distance inland from the coast, extending along the lower reaches of Churchill and Nelson rivers, is underlain by flat-lying Palaeozoic rocks, is mostly drift-covered and presents a different topographic form from that of the Precambrian Shield which surrounds it.

This Guide deals entirely with Precambrian formations which cover over three-fifths of the Province and are the great hunting ground of the prospector for metallic minerals.

Development of Precambrian Rocks

As stated by DeLury*: "The greater mass of Manitoba's Precambrian is made up of granite, granite-gneiss and granite-like rocks, all of which are known to have been formed from the molten state at great depths below the surface which existed at the time of their formation. Thousands of feet of overlying rocks have been eroded from the Shield area to so expose the granites and allied rocks. Fortunately, some remnants of this former covering are left with the granites. . . . These remnants of formations earlier than the abundant granites, consist of schists, which are metamorphic rocks produced by the alteration of other types, the original nature of which can be made out in many cases. Most of the schists seem to have been derived from sedimentary and volcanic rocks. These were originally flat-lying and covered the Shield area in great thicknesses. They were squeezed and folded into mountain ranges, and granite magmas welled up from beneath. A vast period of erosion followed the folding and igneous intrusion and the mountainous country was reduced to a peneplain about the close of Precambrian time. Erosion went

*J. S. DeLury; Provincial Geologist; and Professor of Geology, University of Manitoba.



SECTION ALONG LINE A-B OF PLAN

IDEALIZED PLAN AND SECTION OF A GEOLOGIC SETTING FAVOURABLE FOR ORE DEPOSITION

so far in some large areas as to completely remove the former covering of the granite, though in other localities large remnants escaped. These remaining patches of schist appear in most places to have been spared through occupying depressions in the roofs of the granite batholiths. Or, they may be explained as being the lower parts of synclinal basins and folds. Since folding and granite intrusion were probably contemporaneous, these two interpretations may be identical.

"The areas of schist are of variable form and size. Most commonly they appear in bands much longer than they are wide; also frequently in lens-shaped bodies and in some cases in irregular, roughly equidimensional patches. In size the schist occurrences vary from a few square feet to ten, or rarely over one hundred square miles. . . . The dips vary from horizontal to vertical, but the commonest are very steep. As a general rule it might be expected that the steeper the dip and the wider the band of schist, the deeper it would extend into the surrounding granite."[1]

Types of Mineral Deposits

"Mineral occurrences of the Precambrian are largely metalliferous deposits which have been introduced by intrusions of deep-seated igneous rocks. However, the intruded rocks, such as the schists, are the ones which characteristically are mineralized by the intrusives, and they occupy relatively small areas.

"*The schist (greenstone) areas are the ones that are sought by the prospector, and the ones most likely to yield economic mineral deposits*. . . . Since the country is deeply eroded, ore deposits of high temperature types of origin are the ones to be expected, and so far they are the kind most frequently met.

"In areas deeply eroded like Manitoba's Precambrian, magmatic segregations, pegmatites, contact metamorphic deposits and deep veins are the ones to be expected. Deposits akin to all of these have been found. Veins of intermediate depth will be rare, and those of shallow depth probably lacking. A general conclusion may be reached from this that the following metals are possible of commercial occurrence: tin, tungsten, molybdenum, nickel, copper, gold, zinc, platinum group of metals and arsenic. The metals like antimony and lead may appear, but probably in scattered bodies of no commercial value. Mercury is not to be expected except in traces.

Influence of Erosion

"While the great erosion of the geologic past determined that only the deeper deposits and those of high temperature will be encountered, the latest feature of that erosion determined something else of extreme importance. Pleistocene ice-sheet erosion has stripped the country of weathered products. Any secondary ores which may formerly have existed in the upper parts of Precambrian deposits were dissipated by the ice. Only primary deposits are left. . . . The existence of primary ore at or near the surface has an important bearing on prospecting. The prospector, without sinking a shaft, is able to see the nature of the ore. . . .

Associated Intrusive Rocks

"*So far, in Manitoba, the deposits proved to be of most economic importance are sulphide bodies carrying copper and zinc and some precious metals, formed by replacement at considerable depth, and gold veins in rocks which have been intruded by granites.* . . . Other types of ore also occur, such as copper-nickel deposits associated with gabbro intrusions . . . . and occurrences of tin, molybdenum and lithium in pegmatites."[2]

According to Wright*: "An examination of the geological maps of the important mining camps of Quebec, Ontario, and Manitoba shows that the gold and copper deposits of these areas are within the lavas and sediments of pre-granite age—Keewatin—and are connected in origin with intrusive rocks, in many cases granitic in composition. *An opinion is also growing that the large and commercially valuable metalliferous deposits are associated with the small rather quickly cooled intrusive bodies, and rarely occur along the contacts where erosion has gone deep, exposing great areas of granite.*"[3]

Favourable Host Rocks

The known mineral deposits of importance are in volcanics and associated rocks, sedimentary gneisses, intrusive bodies of quartz gabbro and granodioritic phases of the granitic intrusives. So far the thick-bedded arkose and conglomerate beds have not been proved to carry mineral prospects of merit. The sulphide and quartz bodies are in chloritic and sericitic schists produced by faulting in acidic and basic lavas, and also

*J. F. Wright; Consulting Mining Geologist, Winnipeg, Man.; formerly with Geological Survey of Canada.

in bedded tuffaceous layers. *In prospecting, the wide schistose zones should first be located and subsequent work limited to a detailed exploration of the belt of deformed rock.* Many of the schist zones follow lake basins or swampy depressions for a large part of their length, consequently many of the deposits discovered to date are located along or near lake shores.[4]

As regards gold, the occurrences in western Ontario and northeastern Manitoba indicate that the majority of the discoveries are in basic lava, only a few occurrences being in acid lava, sediments, granite, quartz porphyry, diorite and gabbro. Many deposits, however, are in schist, derived from basic lava, that is cut by dykes of quartz porphyry, or these dykes occur nearby. *The association of gold-bearing quartz and dykes of quartz porphyry is widespread, and hence all schist zones cut by dykes and especially by quartz porphyry, should be prospected very closely. The wide brecciated and silicified zones that carry stringers of vein quartz and sulphides should be investigated thoroughly.*[5]

As stated by Knight*: "The great gold mines of Central Canada occur along, or near narrow belts of closely folded sediments, these belts resting on a basement consisting of basic lava flows of stupendous thickness belonging to the Keewatin series. . . . *They are practically all associated with intrusives of 'porphyry,'* such as feldspar porphyry, quartz porphyry or syenite porphyry. . . . As a general rule the sediments are characterized by the presence of coarse boulder conglomerate with which are associated greywacke, quartzite and slate. The beds are nearly always resting in more or less vertical attitudes."[6]

*C. W. Knight; Consulting Geologist, Toronto, Ont.; formerly with Ontario Dept. of Mines.

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2. Ibid pp. 44-45.
3. Geol. Surv., Canada, Sum. Rept. 1927, pt. B, p. 80.
4. Prospecting Areas of Northwest Manitoba; Trans. Can. Inst. Min. & Met., vol. 34, pp. 89-90, (1931).
5. Geology and Gold Prospects of the Area about Island, Gods and Oxford lakes, Manitoba; Bul. Can. Inst. Min. & Met., p. 450, (Aug. 1932).
6. Central Canada's Gold Belt; Can. Min. Jour., vol. 54, pp. 98-101, (March, 1933).

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THE INTERPRETATION OF A GEOLOGIC MAP

The following description of a favourable geologic setting for an ore occurrence may prove to be of assistance to prospectors who are not particularly familiar with the interpretation of geologic maps. In addition to indicating the topographic features of an area, geologic maps show the variety of rock types occurring in the area by means of a legend. The legend may be shown on the map by the use of various colours, or in some cases by the use of a significant pattern. As colouring shows up rock relationship much more clearly, it would be wise for all prospectors to colour any geologic maps they possess, instead of using a pattern. Important rock differences may be overlooked in maps possessing only a pattern.

WHAT THE LEGEND MEANS

The legend is always given with a geologic map and it indicates in addition to the rock type, the age relationship of one rock form to another. As may be seen in plate facing page 19, the volcanics and sediments are the oldest rock forms and so are placed at the bottom of the legend. Think of rock forms on a legend as you would a pile of blocks, the bottom block being the first one to be placed in position.

STRUCTURAL SYMBOLS

Certain symbols appear on geologic maps to indicate the attitude of major rock forms. These symbols are useful for interpreting rock structures and relationships over wide areas. Their meaning is usually explained together with the legend. Symbols of strike and dip are most important and indicate the direction or alignment of a rock formation measured on a horizontal plane; dips are measured in a direction at right angles to the strike. It will be seen on plate facing page 19, that one ot the shear zones strikes at a slightly different angle from that of the bedding of the rock and also dips 8 degrees steeper. Such structures are worthy of note, as they may indicate a persistence of strength to the shear zone bearing ore minerals.

Historical Information

The plate facing page 19 is taken to represent an idealized plan view of an area favourable for prospecting. By considering both the plan and the structural cross-section of the plan along the line A-B, something of the history of the area may be worked out and the events leading up to the development of the ore-deposit may be traced.

Sedimentary and volcanic rocks which originally had formed flat-lying surface deposits were buried under accumulations of thousands of feet of sediments and then, due to adjustments at or near the surface of the earth, were thrown upward into folds, the extremities of which formed mountainous areas and bases of which became engulfed in large masses of granitic rocks which intruded them.

The granitic rocks may have caused the folding of the flat-lying beds by their forceful intrusion. The changes which interest the prospector, however, took place during the extremely long period during which the granite was cooling. It has been noticed that many areas of granite have border phases of a somewhat differing composition, as also have small intrusive masses which have invaded the folded volcanics and sediments. These basic border phases are often related to the intrusive granite and may represent either the original composition of the granite or else the product of reaction of the granite with a rock of differing composition over a long period of time.

Formation of Ore Deposits

As cooling proceeded within the main granite mass, vast quantities of water vapour and other gases migrated to the top of the granite batholith and became concentrated in the peaks of irregularities in the roof of the batholith where they developed sufficient pressure to form channels or openings for themselves in the cooler surrounding rocks (sediments, volcanics and early marginal phases of the granite). The long-continued streaming of these hot aqueous vapours produced what is spoken of as a hydrothermal alteration in the vein walls and replaced many of the original minerals in the rock.

Now, granite bodies as a whole do not contain economic amounts of metals such as copper, gold, silver, lead, zinc, etc.,

but all of these metals are present in small quantities and the gases and water vapour gathering at the top of the batholith in passing through a large volume of the rock collected in soluble form considerable amounts of these metals which they again deposited in passing into the cooler portions of the vein.

Localization of Ore Deposits

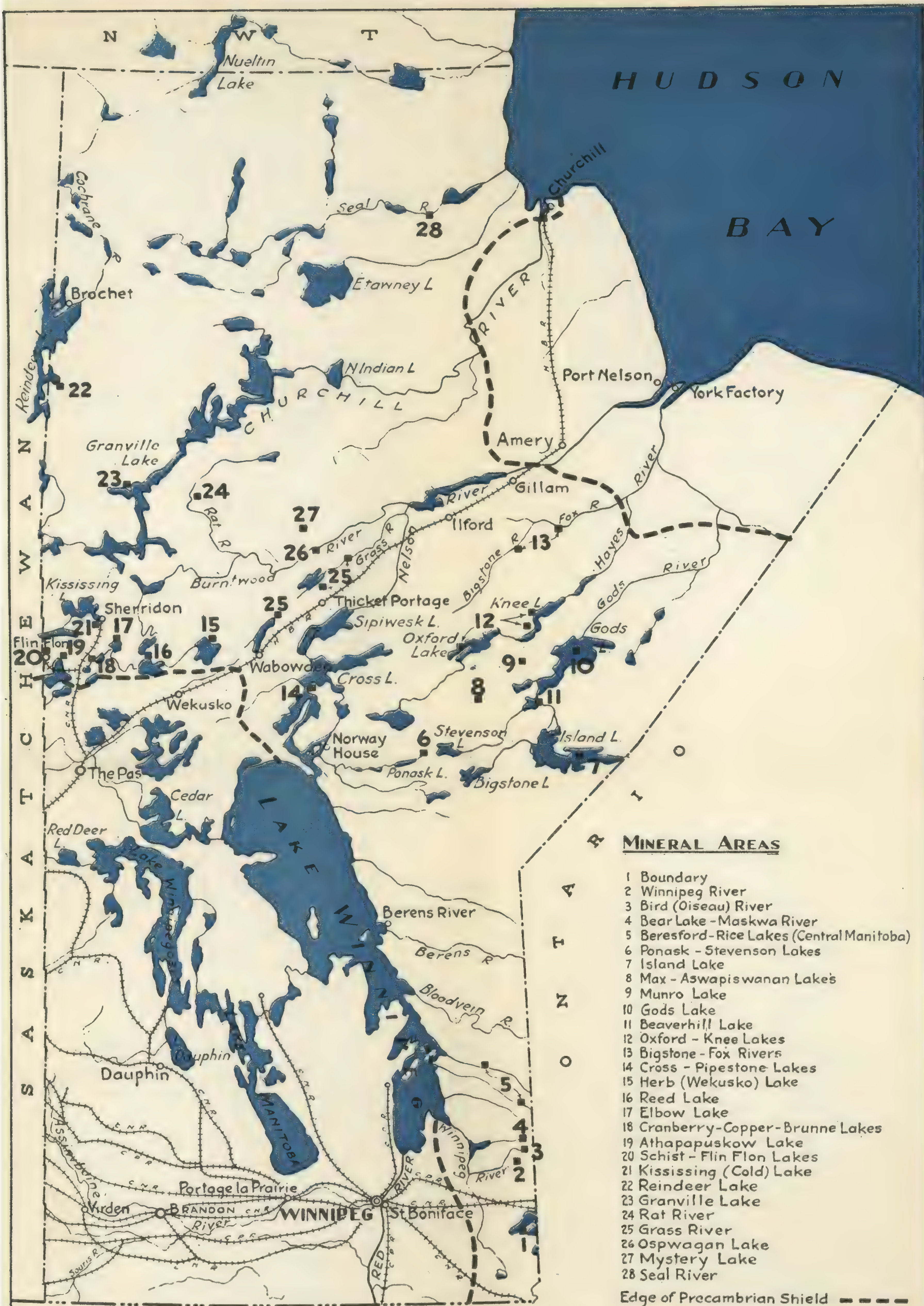
So it becomes evident that if we look for rock forms which represent the end stages of igneous activity, it will be in and around them that ore deposits will be encountered. Look at the legend. *The youngest rock or mineral body found in the map area is the quartz vein, and the next youngest is the quartz-feldspar porphyry dyke. Then since these two rock forms represent the end stages of granite intrusion, it is in their neighbourhood that a search should be made for ore deposits.*

A study of the plan and sectional view will show why it is best to prospect off the end of masses of porphyry or small igneous intrusions. They have split open the rocks, thus permitting the passage of solutions into the surrounding rock mass.

All of this, however, took place far below the surface of the earth and these deposits were formed at several thousands of feet in depth. Erosion over much of the geologic past has, however, levelled the folds that formed the mountainous ridges so that the rocks which now are exposed at the surface are those remnants of rocks, older than the granite, which have been engulfed in it. The tops of the original ore deposits have to a large extent been removed. This does not imply, however, that the deposits as they now exist will not continue to many hundreds of feet in depth.

A glossary, to which the reader is referred, is appended to this publication for the use of any to whom some of the rock and mineral terms may be unfamiliar.

PART III



Scale: 60 Miles to 1 Inch

MAP SHOWING PRECAMBRIAN MINERAL AREA OF MANITOBA

0 10 20 30 40 50 60 120 Miles

MINERAL AREAS

The mineral areas which are described in the following pages receive their names from some lake, river or other prominent topographical feature to which they are respectively tributary. They are localized areas of Precambrian lavas and sediments in the much larger masses of granite, granite-gneiss and granite-like rocks that occupy the Precambrian shield. Many metalliferous deposits have been discovered in the better-known areas, but *large stretches of favourable territory which have been explored only to a limited extent still await the prospector.*

The problem of correlating areas of Precambrian rocks which are separated by wide intervening stretches of granite is one of the most difficult tasks in geology, and for this reason it has been the custom of geologists who have mapped the different areas to apply local names to the strata occurring in each area. Hence, there appears to be the same type of volcanic rocks variously named as the Hayes River group, the Kiski volcanics, the Amisk volcanics, according to the areas in which they occur, and, similarly, beds of sediments which may or may not be related are named Island Lake sediments, Oxford sediments, Missi sediments, Sickle series, in the different areas. The large area of sedimentary rocks extending from the Manitoba-Saskatchewan boundary east through Kississing and Loonhead lakes to Herblet lake and beyond are known as the Kisseynew gneisses.

BOUNDARY AREA

The Boundary area includes that part of southeastern Manitoba which lies along the Manitoba-Ontario boundary between the Canadian Pacific and the Greater Winnipeg Water District railways. Mainly in townships 8 and 9, range 17, east of the Principal meridian, the area contains West Hawk, Falcon and Star lakes, and may be reached by Canadian Pacific railway to Ingolf and thence southwesterly by winter trail, a distance of 4 miles to West Hawk lake. The Manitoba section of the Trans-Canada highway passes between West Hawk and Star lakes, and is now used to reach many points in the area which forms part of the White Shell Forest Reserve. Claims may only be staked in this reserve and recorded in accordance with regulations 13 and 14 for the Disposal of Mineral Claims, as well as with requirements of the Forest Act.

Rocks of the Area

The rock formations of the Boundary area are very similar to those of the Lake-of-the-Woods country, which lies to the east. These include schist and slate-like rocks, derived chiefly from basic volcanics, but also to some extent from other volcanics and sediments. These rocks have been invaded by granite magmas. The schists occur in a variety of forms, from lens-shaped and dyke-like bodies to fairly continuous bands up to 5 or 6 miles in width. The north shore of Falcon lake marks the southern limit of the prominent outcrops of schist.

While there is a distinct gradation in the metalliferous content of the different mineral deposits in this area, they grade into one another, and the most of them indicate a genetic relation to the granite.

Pegmatite Dykes.—Pegmatites are prominent particularly in a belt striking northeast along the western side of the main belt of schist where these rocks are in contact with the large granite area lying to the west. Dykes occur in the granite itself, but those of economic importance are in the schist areas, commonly within a few hundred feet of the granite contact. They are mostly tabular bodies from 2 to 10 feet in width and are usually parallel to the schistosity of the surrounding rock.

Mineral Occurrences

Molybdenite is the only prominent metallic mineral in the pegmatites. It occurs commonly as crude crystals up to 3 inches in width. The massive fine-grained variety is less abundant. The principal occurrences are in dykes in schist about 2 miles north of the west end of Falcon lake. Near the south shore of West Hawk lake and farther from the contact there is an occurrence of the lithia silicates, lepidolite and spodumene in a pegmatite body.

Fine-grained and disseminated molybdenite occurs in a group of parallel stringers of quartz at the east end of Falcon lake on both sides of the interprovincial boundary.

Scheelite has been found in small quantities in many places in the belt of schists to the north of Falcon lake and surrounding Barren, Star and West Hawk lakes. Small amounts of pyrrhotite, chalcopyrite and sphene also appear in some of the deposits. These minerals have been formed along zones of movement

indicated by fault-breccias and slickensided surfaces on well-defined walls.

A notable feature of the area is the occurrence in the schist of large sulphide zones, some of which extend over several claims. These zones occur on both sides of West Hawk lake and in the Star and Falcon lake areas. The prominent sulphides are pyrrhotite and pyrite, though pyrite, chalcopyrite, sphalerite and galena are prominent in some of the smaller veins.

Gold-quartz veins have been found at several places, most of them near the margin of a syenite boss that outcrops south of Star lake. They occur in the syenite itself and in the neighbouring schists.

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WINNIPEG RIVER AREA

The Winnipeg River area comprises the country bordering Winnipeg river from Pointe du Bois east to the Manitoba-Ontario boundary.

Pointe du Bois, the point of entry into the area, is located on Winnipeg river 20 miles due east of Lac du Bonnet from which it is easily reached by the railway of the Winnipeg Hydro-electric system. Lac du Bonnet, in turn, is reached either by Canadian Pacific railway, 66.5 miles, or by motor road, 72 miles, from the city of Winnipeg.

From Pointe du Bois east to the boundary, Winnipeg river is navigable to canoes and motor boats.

Rocks of the Area

The oldest rocks in the area are the sediments and volcanics, while the major intrusives of the area comprise granite masses of several compositional types which are probably the result of a single period of magmatic activity.

A microcline granite is the most widely distributed and extends across the middle of the area for a length of 60 miles. Near the interprovincial boundary it has a width of 27 miles. This granite is generally uniform over great distances and is characteristically massive although in places gneissic.

An oligoclase granite occurs over most of the area, but its continuity is interrupted by large and small areas of the microcline type. The composition, colour, texture and structure of the oligoclase granite vary over short distances. Commonly the structure is somewhat gneissic, while in many places the rock is a well-banded gneiss.

The contact between the microcline and oligoclase granites is indefinite. Both types occur in a mixed zone from ¼ to 3 miles or more in width.

Two main types of albite granite are discernible, varying in colour from white to pink. Mineralogically they are albite-muscovite and albite-tourmaline granites, the former usually containing small amounts of biotite. These granite types occur intrusive into a belt of volcanics south of Winnipeg river extending 4 miles east of Lamprey falls in a discontinuous zone. They form only small masses, the largest being 2½ miles in length and ½ mile in width.

The minor intrusives include dykes of granite, aplite, and pegmatite as well as lenticular bodies of pegmatite. The dykes vary greatly in size up to 60 feet wide and 1,500 feet long. Commonly they are from 2 to 10 feet wide and usually have straight parallel walls. Close to the borders of the larger masses of albite granite are a few dykes of the same rock, also albite aplite, albite pegmatite, microcline pegmatite and many dykes that are a mixture of microcline pegmatite or one of the types just mentioned. What appear to be phases of the albite pegmatites are the lithium-bearing masses. These occur in the same areas as does albite pegmatite except in two instances,

namely, in oligoclase granite, north of Winnipeg river, and in volcanics on English river, near the interprovincial boundary.

Lithium Deposits.—The discovery of a deposit of lithium minerals on the Bear mineral claim in 1924 attracted attention to the Winnipeg River area as a possible source of lithium. During the following two years other deposits were discovered at Bernic and Cat lakes to the north, and Winnipeg river.

The following are the lithium-bearing locations at which work has been done:

The Bear mineral claim, 3 miles south of east from Lamprey falls on Winnipeg river. This deposit was taken over by the Silver Leaf Mining Syndicate (Canada) Limited, and considerable development work was done. Small shipments were made to various countries, including United States, England and Germany.

The Annie mineral claim and Gray mineral claim, 3/8 of a mile northeast and 1/4 of a mile northwest respectively, of the dyke on the Bear claim.

The Captain group of claims in the southern portion of section 14, township 16, range 16, east of the Principal meridian, 3 miles slightly south of east of the dyke on the Bear mineral claim.

Near the east end of Bernic lake nine lithium-bearing dykes occur over an area 500 feet wide and 3,000 feet long.

Five dykes occur at Cat lake in the central part of township 19, range 15, east of the Principal meridian, 12 miles north of Bernic Lake deposits.

In lithium pegmatite, albite predominates over microcline and is usually the cleavlandite variety. Quartz and muscovite are important constituents; biotite is lacking. Coloured tourmaline, garnet, apatite, beryl, topaz, fluorite, tantalite-columbite, monazite, and calcite are locally present. Lithium minerals, including spodumene, lepidolite, zinnwaldite and a variety of other lithium-bearing micas, are present in large or small amounts.

Prospectors in search of lithium deposits in the area should keep in mind the relation of lithium pegmatite to the major granite intrusives. Search should be made in areas of sediments, volcanics and oligoclase granite close to the edges of intrusions of albite granite. In some areas albite granite is not exposed at the surface, but its presence close beneath may be indicated by a

group of albite-bearing dykes. *Lithium deposits may also be found at considerable distances from the edges of microcline granite intrusives, as in the West Hawk Lake area.* They are quite unlikely to occur within intrusions of microcline granite or in the areas of oligoclase granite, sediments, or volcanics which contain numerous dykes of microcline granite, microcline aplite, or microcline pegmatite.

Beryllium Deposits.—Beryl, a mineral containing beryllium, occurs in pegmatites mainly in the same localities and even in the same deposits as the lithium minerals, hence it is unnecessary to discuss the mode of occurrence of this mineral.

In the lithium-bearing bodies beryl is most abundantly present in the Bernic Lake deposits, but also occurs in the Cat Lake deposits, on the Bear, Annie and Gray mineral claims, and on the Captain group of claims. These have been mentioned among the lithiums.

Stockwell* noted beryl in eleven non-lithium bodies. Three of these occur at Cat lake and consist chiefly of albite aplite, in which are patches of quartz-muscovite rock. Other occurrences are on the Captain claims in a dyke 2 miles southwest of this group; two microcline pegmatites in the northeast and northwest corners of section 1, township 15, range 16, east of the Principal meridian.

The outstanding discovery of beryl in the region is in a pegmatite dyke on the Huron claim which is about ½ mile inland from a point on the southeast shore of Winnipeg river, 9 to 10 miles above Pointe du Bois in the vicinity of the lithium dyke on the Bear claim. The zone carrying beryl on this claim is about 20 feet wide, and the richer portions with more massive beryl are 8 feet wide.

Other deposits of beryl occur at Shatford lake, at several places near Bernic lake and at other localities. Regarding the economic possibilities of the deposits in Manitoba, DeLury says,

"A great deal must be done still to prove that large tonnages of beryl can be shipped from Manitoba, but there is one deposit at least and perhaps several more to be proved and found, that give high hopes that the Province may be a producer when the time arrives for a large consumption of the metal beryllium."

*C. H. Stockwell, Geologist, Geological Survey of Canada.

Fuchsite-bearing Rock.—Fuchsite or chromium mica occurs in quartzite on the Vernon mineral claim in the southwest part of section 13, township 16, range 15, east of the Principal meridian. A road, ¾ of a mile long, furnishes access to Winnipeg river, from which point it is 6½ miles by water to the railroad connection at Pointe du Bois. In 1926, 150 tons were shipped to Winnipeg for use as stucco dash.

The fuchsite occurs in a narrow band of quartzite, bordered on its south side by grey oligoclase granite and on its north side by basaltic lava. The quartzite locally known as "pearl rock" contains a pale green bed about 3 feet wide, in which the fuchsite occurs in lenses measuring up to 3 feet by 1 foot. The fuchsite has a bright green colour, is schistose and contains small amounts of quartz and a black opaque mineral in microscopic grains. It has probably been formed by metamorphism of original constituents of the quartzite.

Tin Deposits of Shatford-Bernic Lakes.—Tin was first discovered in 1924 in a pegmatite outcropping on a small island in Shatford lake. Some claims were staked that year by K. E. Miller, but nothing further was done until 1928 when efforts were made to develop the deposit. A staking rush followed in the area early in 1929, and other occurrences of tin were discovered.

The assemblages of volcanic and sedimentary rocks of the area are very like members of the Rice Lake series of the Beresford-Rice Lakes area to the north. The chief bedrock formations in the vicinity of Shatford and Bernic lakes are:

(1) White and pinkish grey pegmatitic albite granite and albite pegmatite and aplite (some bodies tin-bearing);
(2) Pink and pinkish grey microcline granite;
(3) Porphyritic and non-porphyritic quartz diorite, granodiorite and granite;
(4) Pinkish microcline pegmatite;
(5) Garnet beds;
(6) Basalt, andésite, greywacke and tuff.

Cassiterite (tin oxide) occurs in a few pegmatites in the vicinity of Shatford and Bernic lakes. The few tin-bearing pegmatites are characterized by an abundance of soda feldspar in contrast with the pink, potash feldspar so abundant in the area. The cassiterite is confined within the pegmatite to either

coarse- or fine-grained phases that form pockets either irregularly distributed throughout the whole body or confined to the hanging-wall side of flat-dipping bodies. No typical greisen has been recognized in the area.

Two pegmatite bodies occur approximately 2,200 feet west and north respectively, of the west end of Rush lake, in sections 19 and 20, township 17, range 16, east of the Principal meridian. The pegmatite west of the lake lies on the Rush group of claims. The other pegmatite body is on the Stannite group. Only a small amount of surface work has been done on these pegmatites, but all are reported to carry cassiterite in small amounts. Typically the tin mineral occurs as disseminations of small grains and crystals in more or less isolated bodies and pockets in the pegmatite. These bodies may have the tenor of workable tin ores, but they are too small in themselves, and their sporadic occurrences involve expensive development work.

Nowhere in the world have pegmatites been important sources of tin ore. The most important sources of lode tin are quartz veins carrying cassiterite and such characteristic minerals as topaz, fluorite and tourmaline. Near these veins the country rock is altered typically to a quartz-muscovite aggregate known as greisen. Bodies of greisen have been formed mostly at the tops of batholiths. In Manitoba erosion has been carried below the greisen zone in the exposed granite areas, although cassiterite-quartz veins may occur within members of the Rice Lake series along the sides of the granite batholiths. No quartz veins carrying cassiterite and bordered by greisen have been found up to the present.

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BIRD RIVER AREA

The Bird or Oiseau River area lies along Bird river between Lac du Bonnet and the Manitoba-Ontario boundary. The usual method of travel to the area is by motor boat or canoe from Lac du Bonnet, which, in turn, is reached either by Canadian Pacific railway, 66.5 miles, or by motor road, 72 miles from the city of Winnipeg.

Bird river empties into the east end of Lac du Bonnet, an expanse of Winnipeg river, 25 miles above Lake Winnipeg. Eighteen miles above its mouth, Bird river widens to form Oiseau lake, a body of water 4 to 5 miles long and 1 mile wide.

The river, except for a mile portage at the first rapids and five short portages further up-stream, is easily navigable throughout its length in Manitoba. It is 100 to 150 feet wide and flows southwesterly.

At Lac du Bonnet gasoline launches may be obtained to travel the 28 miles between the village and the first rapids in Bird river. Localities between Bird and Winnipeg rivers can also be reached by the railway of the Winnipeg Hydro-electric system from Lac du Bonnet to Pointe du Bois, and thence up Winnipeg river.

Rocks of the Area

All the rocks in the area, excepting the Pleistocene covering of glacial drift, are of Precambrian age. They consist of thick series of sediments and lavas and younger intrusives ranging from peridotite to granite. The sediments and lavas now stand vertically or dip steeply and exhibit all degrees of metamorphism from slightly altered to highly schisted types. These altered sediments and schists lie in a belt 4 to 6 miles wide along the side of Bird river, and to the east are entirely south of Oiseau lake.

Mineral Occurrences

The occurrences north of Bird river include the Chance, Devlin, Wento and Cup Anderson claims. Prior to 1923 surface work was done on the Chance and Devlin deposits, and since that time surface work and diamond drilling have been done at intervals on the Wento and Cup Anderson claims.

The prominent type of mineral deposit in this area is a copper-nickel sulphide body associated with the gabbro and peridotite. The deposits, of which there are several, contain pyrrhotite, pentlandite and chalcopyrite with nickel as the important metal. Wright recognized two other types of sulphide deposits in which copper is the most important metal: chalmersite, chalcopyrite, pyrrhotite and pyrite; and chalcopyrite with minor amounts of sphalerite and galena. Disseminated sulphides cccur at a number of places south of Bird river.

In his discussion of the area, Wright states: "It appears frcm available information that *the areas worthy of intensive prospecting are those wherein andesitic lava flows and tuff beds alternate as they do in the area, ¼ to ¾ of a mile wide, extending from the Wento deposit westward to the east end of Lac du Bonnet.* Drift deposits are widespread in this area."

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BEAR LAKE–MASKWA RIVER AREA

The Bear Lake–Maskwa River area lies about 20 miles north of the Bird River copper-nickel area. It can be reached from Winnipeg by two different routes. One is via Canadian Pacific

railway to Lac du Bonnet and electric railway 14 miles to Great Falls, from which point Winnipeg river is navigable with a few portages to the mouth of Maskwa river, which, in turn, is navigable from its mouth to Bear lake, 4 miles beyond Cat creek.

The other route is by Canadian National railway to Traverse bay, 4 miles south of Victoria Beach, thence by motor boat to Fort Alexander and by canoe to the mouth of Maskwa river, thence, as described in the first route, to the claims.

Air service is maintained from Lac du Bonnet to Bear and Undertaker lakes, a distance of approximately 30 miles.

Rocks of the Area

The predominant rocks in the area are granites and associated granite gneisses. For the most part they are massive light-coloured rocks, but occasionally the foliation is distinct enough to render them faintly gneissic. The remaining rocks are greenstone schists and norite, which occur in the form of an elliptical inclusion in the granite and granite-gneiss.

The norite is a dense, fine to coarse-grained, granular, igneous rock, greyish-black in colour. As well as being the vehicle for bringing in the ore minerals, it has in this locality intruded the greenstones, in the form of a stock-like body and numerous dykes. Associated with the greenstones are smaller areas of metamorphosed sediments.

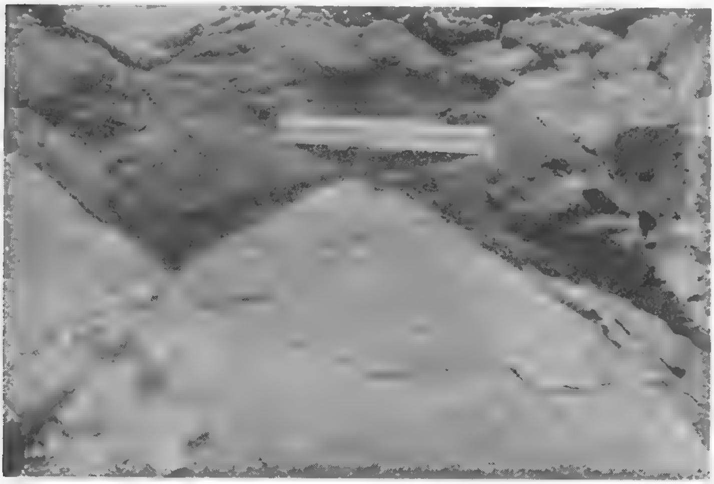
Mineral Occurrences

The ore minerals occur associated with the norite near its contacts with other rocks and also in the norite not adjacent to the contacts. These minerals are magnetite, ilmenite, pyrrhotite and chalcopyrite, all closely associated and intergrown. They occur in blebs, in irregular patches, stringers and veinlets, lying in, surrounding, cutting and replacing the silicate minerals.

Up to July, 1920, 152 claims were staked and considerable surface stripping done in the area. However, the Mayville, the original discovery, was the only deposit where surface exposure appeared promising enough to warrant further work. In 1923 several shallow diamond drill holes were put down. No further work was done until the winter of 1928, when diamond drilling was again undertaken. Five holes were

drilled, three being vertical of approximately 500 feet depth, and two, steeply inclined, 1,500 and 1,400 feet respectively. Diamond drill intersections indicate that the body dips to the south. Short sections of the trenches and drill core assayed over 4 per cent combined nickel and copper, but the average of a body of commercial tonnage is much lower.

On the Hititrite claim, 4,500 feet south of the Mayville, the sulphide-bearing rock, as exposed by five prospect pits, is 125 feet along the strike and has an average width of 15 feet. Assays of channel samples are reported as giving from 0.27 to 3.23 per cent copper and from 0.19 to 1.68 per cent nickel, with one sample giving 0.02 per cent platinum.



Lamprophyre dyke following jointing in granite, Silver Fox mineral claim, Little Bear Lake.

Copper-nickel outcrops are situated along Cat creek in the northwest quadrant of township 19, range 14, east of the Principal meridian.

In the vicinity of Little Bear lake southeast of the Maskwa copper belt, the granitic rocks are cut by numerous sheared lamprophyre dykes.

Several quartz veins have been discovered following the shearing in these dykes. *In this area attention should be directed to these narrow, elongate masses of schist that have provided the structural control necessary for vein deposition.* Sulphide minerals prominent in these quartz veins are pyrite, galena, sphalerite,

chalcopyrite and aikinite(?). These minerals, however, occur only sparingly, but some high values in gold have been obtained. The gold occurs as a telluride and in the native state or finely distributed through the sulphide minerals. The greatest number of these sheared basic dykes occurs south and east of Little Bear lake.

East of this area a distance of 4 miles, lithium-bearing pegmatites have been discovered in the vicinity of Cat lake. Beryllium has also been found in some of the pegmatites.

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BERESFORD–RICE LAKES (CENTRAL MANITOBA) AREA

The Beresford–Rice Lakes (Central Manitoba) area is probably the best known and most important gold quartz area so far discovered in the Province. It extends along Wanipigow (Hole) and Manigotagan (Bad Throat) River systems from Lake Winnipeg east to the Manitoba-Ontario boundary line. The centre of the district is about 100 miles northeast of the city of Winnipeg.

The closest rail points are Pine Falls on the Canadian National railway and Great Falls, via Lac du Bonnet, on the Canadian Pacific railway, from which winter roads, 40 and 55 miles, lead to the San Antonio mine, and to the Central Manitoba and Gunnar gold mines respectively. Air service to the area is maintained throughout the year from Winnipeg and Lac du Bonnet. This service is interrupted only for a short

period during freeze-up and break-up each year, but telephone communication direct from Winnipeg is rarely, if ever, interrupted.

Means of access to the area in summer, other than by 'plane, is by boat from Winnipeg. A bi-weekly service is maintained. The route follows Red river to its mouth, thence across the southern end of Lake Winnipeg to English brook, 8 miles up Hole river. This is followed by a 2 mile portage by truck. The journey is then continued by water, 20 miles upstream to Government Landing on Hole river. A motor road connects this point with Quesnel (Caribou) lake, 17 miles distant to the southeast, where travel is continued by water to the eastern part of the area in which are located the Gunnar and Central Manitoba mines. At about Mile 9 on the road, a short branch road leads north to Rice lake on the north shore of which is located the San Antonio mine. Most of the development work in the San Antonio area may be readily reached from this road.

On the route east from Quesnel lake several small lift-overs and a tracked portage 1½ miles in length have to be made to reach Long lake. A motor road leads from the east end of Long lake northeast 4 miles to the Central Manitoba mine. A side road, 4 miles to the Gunnar mine, branches to the east at a distance of 2 miles from the lake.

Rocks of the Area

The bedrock of the Beresford-Rice Lakes area is of Precambrian age and is divisible into:

1. Volcanic and sedimentary strata; and
2. Intrusions ranging in composition from peridotite to granite.

The gold-bearing veins occur in a belt of pre-granite rocks consisting of lavas and sediments which in some localities are interbedded. The members of this assemblage are steeply folded. Only locally are the dips as low as 45 degrees. This great group of rocks has been designated the Rice Lake series and is divisible into the following phases based on the absence or presence of lavas, and certain other lithological features:

1. The Manigotagan phase.
2. The Beresford Lake phase.
3. The Wanipigow phase.

The Manigotagan phase of the Rice Lake series comprises a variety of sediments including slate, chert, quartzite and greywacke-like rocks. In some areas these beds are altered to quartz-sericite schists or slaty rocks. Sediments belonging to this phase outcrop extensively in the southern part of Beresford-Rice Lake area from Turtle lake south east along Manigotagan valley through Manigotagan lake, south of Long lake to Flintstone lake and up Moose river.

The Beresford Lake phase is made up predominantly of volcanic rocks, although sedimentary strata are locally numerous. The lavas vary in composition from rhyolite to basalt. The rhyolite members are in some places porphyritic. Rocks of this general character are present southeast of Rice lake from near the east end of Long lake east to Garner lake and northwest to and beyond Halfway lake, and south of Lily and Slate lakes. *The deposits of economic interest are in the volcanic rocks locally known as greenstone and in masses of sheared porphyry.*

In the deposition of the third, or Wanipigow phase, vulcanism again gave place to sedimentation. This phase includes the medium- to coarse-grained quartzose sediments which outcrop, typically, west of Rice and Red Rice lakes. The predominant members are thick-bedded quartzite, grit and greywacke with thinner slaty beds and lenses of conglomerate. Volcanic rocks are not widespread, although grey lavas are exposed in a few localities along the Wanipigow valley westward from Rice lake.

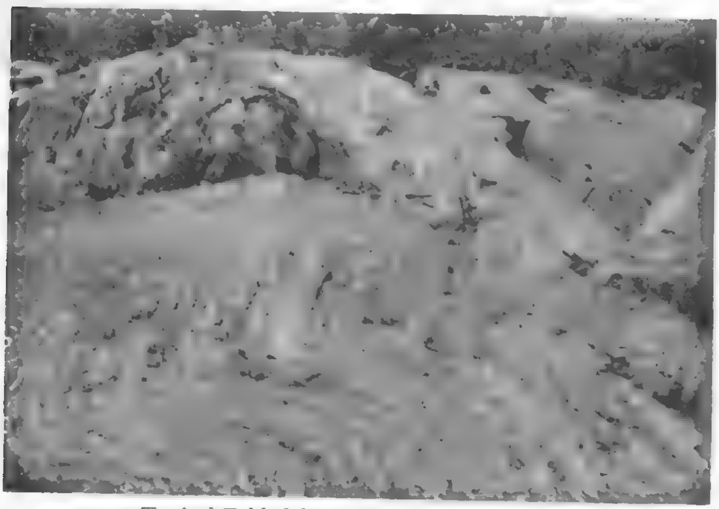
Mineral Occurrences

Wright says of the area,

"The gold deposits are quartz bodies of variable size occurring along shear zones within members of the Rice Lake series and certain of the bodies of granitic rocks cutting this series. Narrow, jointed and schistified zones carrying small bodies of quartz are widespread, especially in the volcanic members of the Rice Lake series, whereas, apparently, at only a few localities are large shear or fault zones developed. Some of the large, persistent shear zones do not contain quartz and others carry large bodies of quartz that is not gold-bearing. Free gold in quartz, however, is widely distributed. . . . Many of the shear and fault zones and their enclosed quartz bodies

are located along structural features, such as the contact between lava flows or the contact between a lava flow and chert, tuff, or quartzose sediments, or the contact of small, intrusive bodies with lava or sediment."

Zones of deformed rock follow closely the dip and strike of the schistosity and the bedding of the enclosing rocks; the angle between the average trend of a shear zone and the strike of the schistosity or bedding of the country rock is in no case over a few degrees. *The best conditions for the formation of large bodies of quartz, however, seem to occur where the shearing makes this small angle with the surrounding rocks.* See Idealized Plan and Section, facing page 19.



Typical Folded Shear Zone, Rice Lake area.

The quartz bodies are divisible into the following four types on the basis of colour, texture and mineral content:

1. Dark, smoky, medium-grained quartz;
2. White, medium-grained quartz associated with abundant carbonates;
3. White, finely crystalline, sugary quartz;
4. White, coarsely crystalline, pegmatitic quartz carrying albite feldspar.

Of these four types, *the first three are considered the most valuable and the ore-bodies at present under development consist of these types of vein material.* In much of this ore the gold is

not visible to the naked eye. A few bodies of smoky quartz are known that do not carry gold and some others carry on the average too little gold to be mined profitably.

Bodies of white, sugary quartz (the third type) are present at the same localities with the smoky quartz and in a few deposits both types are present in the same quartz body. Crystals of calcite, ankerite and siderite are abundant in some of the white quartz, also albite in twinned crystals. The gold lies between quartz grains near nests of carbonates. The gold is erratically distributed throughout the white quartz and for this reason certain samples cut from the bodies of white, even-granular quartz assay high, whereas others do not show a trace of gold and the average for the whole mass may be disappointingly low.

Bodies of the fourth or white pegmatitic variety of quartz are widespread, although only a few masses of this type are present at any one locality. This type of quartz is usually barren of sulphides or other minerals excepting feldspar and some mica. Free gold has been found in quartz of this type; however, the deposits usually do not assay even a trace of gold.

Quartz is invariably present where gold values are secured, and it typically forms the bulk of the deposits. Commonly the country rock adjacent to the quartz is silicified or partly replaced and contains the same ore minerals as the quartz. Ankerite and other carbonates are abundant in the quartz and altered rock in some deposits, but lacking, or in small amounts, in others.

Pyrite is present in all deposits, but varies greatly in relative quantity from a barely perceptible trace to a heavy sulphide ore. Chalcopyrite is also present in nearly all deposits, traces in some and conspicuous in others. Frequently, the highest gold assays come from ores in which chalcopyrite is a prominent sulphide. Gold is practically the sole economic mineral of the district. Tellurides occur, but precious metal tellurides are not anywhere conspicuous. Pyrrhotite is rare and entirely absent from many deposits. Arsenopyrite is not a common mineral and is nowhere abundant, except in occurrences at Wallace lake and southeast of Stormy lake. Small amounts of sphalerite, galena and molybdenite occur in some deposits. Tetrahedrite has been found in one locality. Feldspar, white and green micas and tourmaline are also found. On the

whole the latter minerals are not abundant, but locally any one of them may be a prominent constituent of the ore.

Bodies of carbonate-chlorite schist, and massive, grey, carbonate rock are present along some shear zones. They are extensively developed in the workings of the San Antonio mine.

Some Operations in the Area

The initial impetus to the search for metalliferous deposits in this area was the discovery in 1911 of gold in quartz veins on the shore of Rice lake between Manigotagan and Wanipigow rivers. Since the first discovery, additional finds have been made in the same region each year and the known gold-bearing area has been enlarged to one of considerable size. Gold-bearing quartz veins in shear zones form the only metalliferous deposits of economic interest so far discovered in the area.

The promising prospecting ground of the Beresford-Rice Lakes area is approximately 60 miles long and varies in width from 1 to 15 miles. The best known portions of the area are:

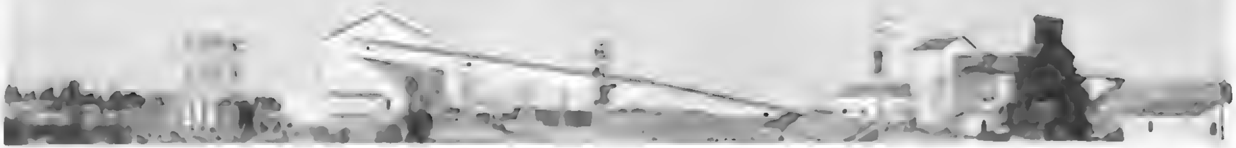
1. **That surrounding Rice, Gold and Clearwater lakes.**
2. **That enclosed in the Long-Halfway-Beresford Lakes triangle.**

Both of these have numerous gold-bearing quartz veins and considerable work, both surface and underground, has been done on a number of the more promising veins. The work, however, was done intermittently and for the most part by interests lacking sufficient capital to carry out adequate exploration. Moreover, except during two or three boom periods, comparatively few prospectors remained continuously in the country.

Occurrences of gold have also been found in Anderson Lake area, and along the Wanipigow River system from the San Antonio mine west to Lake Winnipeg.

The operations at the Central Manitoba, San Antonio and Gunnar mines *have established the existence of important ore-bodies in their respective localities.*

Central Manitoba Mine.—At the Central Manitoba mine the ore zone follows a more or less continuous shear striking south 74 to 81 degrees east and dipping from 65 degrees south at the west end of the property to 85 degrees north at the



Mill

Kitchener Shaft

Central Manitoba Mine

View of Mine Buildings, Gunnar Mine
Near Beresford Lake, 193[illegible]

extreme east end of the property. At the west end the quartz bodies are localized along the contact of a mass of diorite or gabbro, which forms the foot-wall, and a band of cherty sediments and andesite pillow lava, which form the hanging-wall of the deposit. Towards the east, the shear bearing the quartz passes into the diorite. In the workings on the Hope mineral claim at the eastern end of the deposit all of the quartz mined is taken from a shear zone entirely within the diorite.

The ore-shoots of the Central Manitoba mine occur as lenticular masses of quartz and vary greatly in size. Widths up to 15 feet are found in some of the stopes. The quartz is coarse- to medium-grained bluish to smoky white and has been fractured, allowing the introduction of pyrite and chalcopyrite carrying the gold values. Locally pyrrhotite is abundant. Free gold is almost entirely absent from the veins although 75 per cent of the ore value may be recovered by grinding to 80 per cent minus 200 mesh and amalgamating. Most of the ore to date has been mined above the 375-foot level.

San Antonio Mine.—Especially noteworthy is the geologic setting of the San Antonio mine. The host rock into which the vein material has been introduced is a dark green rock of variable texture and degree of alteration, probably a diabase. It is intrusive into sediments (pyroclastic) and volcanics of the Rice Lake series. The diabase is of variable width and appears to have its greatest width towards the eastern end of the property, being divided at the west end of Rice lake by a wedge-shaped mass of quartzose sediments. The volcanics and sediments along the north shore of Rice lake are also intruded by an elongate mass of diorite porphyry which so far appears to have no genetic relationship to the ore-bodies.

In the veins, quartz albite and carbonate are the dominant gangue minerals. Pyrite is the only sulphide of importance. Chalcopyrite is occasionally present. Sphalerite and galena have been noted, but are rare. Best gold values are generally associated with bands or blotches of fine to very fine pyrite, although this texture is not essential for values. Certain sections of ore will contain appreciable amounts of fairly coarse free gold in addition to the pyrite, but this is not typical of the ore as a whole.

Wall-rock alteration varies. There is comparatively little along the No. 16 vein. On the other hand the tonnage of some stopes is entirely derived from pyritized altered wall-rock and stockwork.

The two most productive veins, the No. 16 and the No. 26, strike almost at right angles to each other. They meet in the stopes immediately above and below the 300-foot level, the No. 16 ore-shoot raking to the northeast, the No. 26 to the northwest.

The No. 16 vein strikes north 60 degrees east with a northwest dip varying from 45 degrees above the 300-foot level to from 60 to 70 degrees below that horizon. The vein occupies a narrow shear, averages 4 feet in width and is often featured by thin bands of fine pyrite and included schisted country rock parallel to the vein walls. Vein breccia is to be noted, but it is not nearly so common as in the No. 26 vein.

The No. 26 vein is, for the most part, irregularly vertical as it twists along a strike approximately north 35 degrees west. The central portion of the vein is a sinuous body of quartz having associated with it varying quantities of vein breccia, alteration and stockwork. The vein proper varies in width from a few inches to several feet, and may or may not be marked by a heavy streak, or a number of parallel streaks, of fine pyrite. Numerous complementary stringers branch off from the central portion and are of similar mineralization to the vein proper. They, together with varying amounts of alteration, stockwork and breccia and occasional auxiliary veins, have been responsible for stope widths as great as 40 feet.

In the area surrounding the San Antonio deposit, *it is significant to note that the concentration of gold values frequently occurs where bodies of quartz lie in or abut against masses of basic rock or volcanics.* It would appear that the ease of alteration by vein solutions of the constituent minerals of the more basic rock types has aided rock alteration to a stage favourable to the deposition of gold.

Gunnar Mine. — At the Gunnar mine, narrow, well-mineralized quartz veins have followed shear zones developed along the flow-tops of lavas. The veins appear to be genetically related to the Tinney Lake granodiorite mass, but dip away

Early Days at San Antonio Mine
No. 2 Shaft
Rice Lake, 1929

No. 3 Shaft Mill *Photo by J. P. de Wet*

Manitoba's First Dividend-paying Gold Mine, San Antonio

from the intrusive contact at the surface into the volcanic rocks. The youngest dyke rock on the property is a biotite lamprophyre. The vein material consists of quartz, carbonate, pyrite, chalcopyrite, dark sphalerite and gold. Most of the gold may be termed "free-milling."

The Oro Grande shear west of Beresford lake is in the east side of a body of medium-grained, basaltic rock between beds of andesitic lava and tuff.

The Diana (Gem lake) deposit is along a wide, schistose zone developed within andesitic lava adjacent to a body of medium-grained basaltic rock.

The shear zones in the granitic intrusives, as at the Eldorado property and the Luleo property west of Beaver lake, are within central parts of tongue-shaped bodies of intrusive rock, or else close to the contact of these bodies with the lavas and sediments.

It thus appears that *areas underlain by rocks of varying competency under deformation are favourable to prospect, and,* perhaps, the variable texture and composition of the volcanics and sedimentaries of the Beresford Lake phase of the Rice Lake series explain the localization of the majority of the quartz bodies of the district to areas of these rocks, as contrasted with the sedimentary Manigotagan and Wanipigow phases of the series, which consist of rocks that are fairly uniform over considerable areas and are practically barren of quartz bodies.

The Beresford-Rice Lakes area during the last 20 years has been the scene of much prospecting activity that reacted in an erratic and intermittent manner to the ability of the prospector to raise money for his endeavours. Many promising showings have attracted attention for a couple of years only to be lost sight of through lack of funds or failure on the part of the prospector to trench into deep overburden or across the entire width of shear zones. Systematic and careful sampling has been lacking on many deposits which might stand up better under careful work. Fractioning of channel samples across many shear zones in some cases gives surprising results and may serve to give the clue to the limits and extent of an ore zone that would otherwise be missed if the entire sample were considered.

Two noteworthy examples of what may be done by prospecting old workings may be cited in the properties of the

Gunnar and Gold Lake mines. Both these bid fair to become producers, and both have their ore-bodies adjacent to or along old workings which, had they been prospected more thoroughly, would have yielded mines at least five years sooner.

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PONASK-STEVENSON LAKES AREA

Ponask and Stevenson lakes are situated due east of the north end of Lake Winnipeg, about midway between Norway House and Island lake. Both are on the water route to Island lake. Ponask lake, the most westerly of the two, is reached by canoe and outboard motor via Gunisao and McLaughlin rivers, and Ponask creek, in from two to three days' travel. Fourteen short portages are made en route. The west end of Stevenson lake is only 6 miles east of Ponask lake, but the canoe route connecting the two lakes is about 24 miles long and leads from the south shore of Ponask lake over the height of land via two portages each about ¼ mile in length, followed by two 1-mile portages, and then via Lonenest and Pelican lakes and their connecting streams into the south side of Stevenson lake.

Rocks of the Area

A long narrow schist belt of altered Precambrian sediments and volcanics, having an average width of from one-half to three-quarters of a mile, extends along the southern shores of both lakes for a distance of at least 55 miles. *The belt may extend through to Island lake, where similar rocks were mapped as the Hayes River group.* If so, it has a length of some 80 miles west of Island lake.

The following succession of formations may be adopted tentatively:

Precambrian	Intrusives	Pegmatite Dykes
		Granite and Granite Gneiss
	Volcanics and Sediments	Intermediate to basic Volcanics and derived Schists
		Conglomerate, Greywacke, Quartzite, Slate and derived Schists

Volcanics outcrop along the entire south shore of Ponask lake, the sediments being mainly in the lake. On Stevenson lake the volcanics are found in smaller proportions. Throughout the belt they are usually found lying immediately south of the sediments and seem to occur as more or less lenticular masses, whereas the sediments maintain fairly regular thicknesses.

Granites lie to the north and south and are intrusive into the older rocks. Pegmatite dykes occur chiefly on the north shore of Ponask lake.

Mineral Occurrences

A few lenticular quartz veins are reported in the Volcanic-Sedimentary complex. Some carry pyrite and chalcopyrite.

Greer states,

"A remarkable feature of the granite-volcanics contacts is the abundance of small quartz veins intrusive along the strike of the volcanics. . . . "

They were especially noted southeast of the second portage below Ponask lake and south of the east end of Stevenson lake.

The area received little attention from prospectors until late in 1933, when a discovery was made near the east end of Stevenson lake. A small staking rush resulted and about one hundred claims were staked at Stevenson and Willow lakes.

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ISLAND LAKE AREA

Island lake lies between 53 degrees, 30 minutes, and 54 degrees north latitude, and 94 degrees and 95 degrees west longitude. Its eastern extremity, Sagawitchewan bay, is crossed by the Manitoba-Ontario boundary line and its west end lies due east of the north end of Lake Winnipeg, a distance of about 120 miles. It is about 300 miles by air line north-north-east of the city of Winnipeg.

Island lake is one of the larger lakes comprising the head-waters of Hayes river which drains into Hudson bay. It derives its name from the vast number of islands, 3,475 of which have been mapped and examined geologically.

Since 1931 travel to and from the Island Lake area has been mostly by aeroplane. In winter, planes usually fly from Wabowden, mileage 136.8, on the Hudson Bay railway. In summer they fly from Norway House at the north end of Lake Winnipeg. The flying distances from these two points are 190 and 140 miles respectively.

During summer a water route from Norway House via McLaughlin river, Ponask creek and Ponask and Stevenson lakes is used by parties travelling by canoe. The distance is estimated at 160 miles with thirty-four portages. Four of these over the height of land between Ponask and Lonenest lakes are 1,400, 1,600, 6,200 and 6,500 feet long respectively; and two over a second height of land into Collins bay, Island lake, are 1,650 and 4,300 feet long. Ponask creek is crooked and narrow and difficult to navigate in low water. The trip usually takes from seven to ten days, depending upon load carried and weather conditions.

Island lake was first surveyed and explored by A. S. Cochrane, of the Geological Survey of Canada, in 1878. In 1925 the Topographical Surveys Branch made a control traverse of the lake and in conjunction with the Royal Canadian Air Force photographed the area. In 1927, J. F. Wright, then of the Geological Survey of Canada, made a detailed study of the geology.

Following the publication of his report a few prospectors entered the area during the seasons of 1928 and 1929. Claims were staked at four different points on the lake:

1. On some islands about 3 miles south of the Hudson's Bay post.
2. On Confederation island.
3. On islands lying to the east towards Sagawitchewan bay
4. On Wapus bay.

Interest in the area then waned for several years and most of the claims were allowed to lapse.

Rocks of the Area

The Island Lake area is underlain by rocks of Precambrian age, the oldest of which is a complex of lavas and sediments classified as the Hayes River group. *This constitutes the favourable prospecting ground about Island lake and is 70 miles long and varies in width from 1½ to 14 miles.*

The group is dominantly of volcanic rocks, the sediments, though widespread, being localized to certain horizons alternating with lava flows. Black, medium-grained basalt, black, fine-grained andesite, and grey flows of dacite are abundant. Rhyolite is only locally present as thin flows with dacite and

andesite. The basalt weathers greyish or brownish and some parts of flows are porphyritic with areas containing crystals of feldspar up to 1½ inches long. Pillows are well developed in many flows. All types of lavas are locally altered to schists, containing carbonate, chloritic and sericitic minerals.

The sediments alternating with the lavas include tuffs, chert, iron formation, cherty quartzite, greywacke and thin beds of arkosic and conglomeratic materials.

A younger body of sediments, designated the Island Lake series, occupies a syncline within the Hayes River formations and outcrops on the islands within the east-central part of Island lake. The series has an average dip of about 40 degrees and rests unconformably on the Hayes River rocks which dip at angles of 70 degrees or over.

The Hayes River group is cut by dykes and sills of fine-to medium-grained diorite and gabbro, by granite and granite-gneiss younger than this diorite and gabbro, by small dykes and lenticular bodies of granite porphyry and by dykes of massive diabase, the youngest rocks recognized in the area.

Mineral Occurrences

Small lenticular quartz veins occur at many localities within shear zones in the volcanic members of the Hayes River group. The gold-bearing quartz is medium-grained and white to dark grey in colour, and it occurs as veins, lenses and stringers. The gold is distributed throughout the quartz in small particles. Sometimes it occurs as films in cracks. Some deposits contain, in addition, pyrite, chalcopyrite, sphalerite, arsenopyrite and galena. Most quartz containing galena is gold-bearing, and the most consistent average assays are from schist bodies that carry dark quartz in stringers and veins, the quartz forming over half the area sampled.

Wright says:

"The area that may contain mineral deposits is a large one,"

and in later notes draws particular attention to

"the area around the end of the granite batholith extending east from Loonfoot island"

as a favourable one to prospect

"as some of the lava for several miles west of the granite

is altered to schist, which is sparingly mineralized with quartz and sulphides, and at a few localities the lava is almost completely changed to large bodies of carbonates;" and

"Another apparently lenticular-outlined body of granite, about 16 miles long, lies along the north shore of Island lake, from Pickerel narrows to Cochrane bay, and the lavas and sediments adjoining this mass should be examined carefully. Narrow dykes of quartz porphyry cut the lavas at points along the south margin of this granite body."

Early Developments

In 1931 two groups of claims were staked on islands lying between Confederation island and Sagawitchewan bay. Samples brought to Winnipeg from the westerly group created wide interest because of the uniformly high assay returns in gold. Ventures, Limited, soon acquired the property and a staking rush followed in the winter of 1931-1932.

The original find was diamond drilled during 1932. A mining plant and complete equipment for a 50-ton mill were then freighted to the property by winter road early in 1933.

During 1932 finds were reported in Sagawitchewan bay at the east end of Island lake and at Bigstone and Clam lakes to the west and southwest of Island lake.

References

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"Island Lake Area, Manitoba;" Geol. Surv., Canada, Sum. Rept. 1927, pt. B, pp. 54-80.
"Oxford House Area, Manitoba;" Geol. Surv., Canada, Sum. Rept. 1931, pt. C, pp. 1-25.
"Geology and Gold Prospects of the Areas about Island, Gods, and Oxford Lakes, Manitoba;" Bul. Can. Inst. Min. and Met., No. 244, pp. 440-454, (August 1932).

MAX AND ASWAPISWANAN LAKES AREAS

Aswapiswanan lake is on the canoe route to Gods lake, and Max lake adjoins Logan lake which is crossed by canoe parties travelling to both the Gods and Oxford Lake areas. Some prospecting was done in these belts in 1926, and probably they have been looked over by some parties travelling to and from Gods lake during 1932 and 1933, but no discoveries have as yet been reported.

Narrow belts of Hayes River lavas extend westward for considerable distances from Max and Aswapiswanan lakes. South of Max lake they are separated by two miles of granite. The lavas include massive and schistose basalt, andesite and trachyte. Some schist zones contain veins and stringers of quartz. The quartz and adjoining schist carry sulphides. Enclosed in the lavas are a few horizons of bedded and schisted sediments, some of which are probably partly recrystallized tuffs. Dykes of granite and granite porphyry and narrow dykes of diabase are also present in the lavas.

REFERENCES

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"Oxford House Area, Manitoba;" Geol. Surv., Canada, Sum. Rept. 1931, pt. C, p. 19.

MUNRO LAKE AREA

The Munro Lake area lies due north of Aswapiswanan lake from which it is easily reached by canoe down Mink river about 3 miles and then up a branch stream 1½ miles to Colen lake. From a bay on the north shore of Colen lake a short stream leads into Munro lake.

The area is not known to have been prospected until 1933, when it was visited by several prospectors travelling to or from Gods lake.

A belt of favourable prospecting ground about 4 miles wide extends for at least 12 miles eastward through Munro lake from the north shore of Colen lake.

The rocks are chiefly basalt, andesite, greywacke and tuff of the Hayes River group. The sediments are more abundant within the lavas than in some of the neighbouring greenstone areas and at some horizons they are at least 300 feet thick. Wide belts of schist derived from lava and tuff alternate with massive lava.

The area is cut by many long, narrow dykes of granite porphyry which follow closely the dip and strike of the Hayes River strata. Stringers and veinlets of quartz occur in the jointed granite porphyry dykes and adjoining schist zones. Schist zones carrying quartz and sulphides also occur in the lavas some distance from the porphyry dykes.

REFERENCES

Wright, J. F.:
"Oxford House Area, Manitoba;" Geol. Surv., Canada, Sum. Rept. 1931, pt. C, pp. 20-21.

GODS LAKE AREA

Gods lake lies due north of Island lake, the distance between their closest points being less than 30 miles. It is about 100 miles southeast of Ilford, mileage 286, on the Hudson Bay railway, and 140 miles northeast of Norway House.

Planes now serve the area from Ilford during winter and from Norway House during the summer season. A winter road from Ilford is used for the freighting of supplies and equipment.

The canoe route which has been much travelled since 1932 starts from Norway House and follows Nelson, Echimamish and Hayes rivers to Robinson and Logan lakes. From the south shore of Logan lake the route follows a chain of small lakes to Aswapiswanan lake, and thence by way of Mink river, Touchwood lake and a short stream to a bay in the Indian reserve near the west end of Gods lake. There is a 60-chain portage between Robinson and Logan lakes and thirteen portages between Logan and Gods lakes, one of which is 90 chains long. The remainder range between 8 chains and 40 chains in length. The trip requires about six days' steady travelling.

ROCKS OF THE AREA

The main prospecting area, some 35 miles long and reaching a width of 15 miles at one point, comprises the larger islands in the lake and large stretches of the mainland east of Gods narrows.

The abundant rocks of the area are black and brown, weathering to grey, basaltic and andesitic lavas of the Hayes River group. A few beds of tuff occur between the basalt flows.

A younger series of sediments, classified as the Oxford group, overlie the Hayes River rocks. They consist of a long band of conglomerate averaging about a ½ mile across, arkose, and bed of fine-grained quartzose and clayey sediments. Steeply dipping they lie west of the lavas between these rocks and the granite and appear to be on the south limb of a broad anticline whose crest is occupied by the Hayes River group.

Members of both the Hayes River and the Oxford groups are cut by dykes and bosses of granite, granite porphyry, and gabbro.

Bands of green chloritic schist occur between the ridges of massive lava, and belts of mica ribbon schist, parts of which contain lenses and stringers of quartz and granite, occur at some localities in the Oxford sediments.

The Hayes River lavas on Elk island and the group of islands to the west and northwest contain many dykes of granite and granite porphyry. Gabbro is also abundant as dykes, and lenticular masses particularly in the Oxford series.

Many shear zones in the lavas are quartz-bearing and may also contain pyrite, chalcopyrite, galena and arsenopyrite. *These mineralized belts of quartz and schist in the neighbourhood of granite porphyry dykes are considered worthy of careful prospecting for gold. Discoveries in the area have shown that the tuff beds must be examined carefully, as the main occurrence so far discovered is in a fractured tuff bed carrying numerous quartz stringers.* The tuff bed lies between two basalt flows and is very close to a gabbro sill which intrudes the lavas.

Drift deposits are widespread in the vicinity of Gods lake. Much of the country to the east and southeast of the lake is virtually unexplored. The lake itself covers a considerable area and prospecting has been confined principally to Elk island.

Mineral Occurrences

Three different types of gold occurrences have been noted:

1. A fractured zone in a quartz porphyry dyke. The fractures are filled with blue quartz stringers which carry very fine pyrite and arsenopyrite and some free gold. The porphyry is mineralized with pyrite and pyrrhotite.

God's Lake Mine 1935

2. Zones of silicified andesite schist well mineralized with fine pyrite and pyrrhotite.
3. Tuff beds between basalt flows.

Early Developments

Very little attention was paid to the Gods Lake area by prospectors prior to 1932. A few parties had visited the area at different times and some attention was paid to it during 1928 and 1929 by the Northern Aerial Minerals Exploration Company, Limited, and others. In 1931 the area was explored geologically by J. F. Wright then of the Geological Survey of Canada, who states in the concluding sentence of his report,

"This area would appear worthy of much more detailed prospecting than hitherto has been undertaken."

In 1932 R. J. Jowsey with a prospecting party entered the area and soon made a discovery of gold on a small island north of the west tip of Elk island. Other prospecting parties were quickly on the ground, and during the remainder of 1932 and early in 1933 many other discoveries were made mainly on Elk island.

Many claims were staked during the period and early in 1933 several companies were organized to acquire claims in the area. The first company to undertake active development was God's Lake Gold Mines, Limited, organized by R. J. Jowsey. This company has the original find in the area and in addition several groups of claims extending eastward along Elk island.

Trenching and diamond drilling were done on several veins until it was discovered that a tuff bed, already mentioned, on the Akers group of mineral claims, carried important values in gold. Subsequent developments proved sufficient ore to warrant construction of a 150-ton mill. A power-plant of 1900-horsepower capacity was completed at Kanuchuan rapids some 40 miles southwest of Gods Lake settlement. Milling began within three years of the initial discovery at Gods lake.

REFERENCES

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"Geology and Gold Prospects of the Areas about Island, Gods and Oxford Lakes, Manitoba;" Bul. Can. Inst. Min. and Met., No. 244, pp. 440-454 (Aug., 1932).
Baker, W. F.:
"Geology of God's Lake Gold Mines, Ltd.;" Bul. Can. Inst. Min. and Met., No. 277, pp. 155-162 (May, 1935).

BEAVERHILL LAKE AREA

The Beaverhill Lake area lies immediately south of the west end of Gods lake to which it is connected by 3 miles of stream, including the Kanuchuan rapids.

Hayes River lavas and Oxford sediments outcrop east and northeast of the lake over an area at least 25 miles long and 4 miles wide at one point. The lavas include andesite and basalt. Some flows showing pillow structure are interlayered with beds of tuff and greywacke with slaty cleavage. Wide belts of lava and associated tuff are altered to chlorite and carbonate schist. Some contain stringers of quartz. Granite porphyry, aplite and pegmatite dykes, although not abundant cut the lavas in some localities.

It is not known that the area has been prospected to any extent but in view of the finds in the neighbouring Gods Lake area, the lavas and sediments of the Beaverhill Lake area should be examined carefully.

REFERENCES

Wright, J. F.:
"Oxford House Area, Manitoba;" Geol. Surv., Canada, Sum. Rept. 1931, pt. C, p. 23.

OXFORD-KNEE LAKES AREA

The Oxford-Knee Lakes area lies between latitude 54 and 55 degrees and longitude 94 and 96 degrees. Oxford lake is about 100 miles and Knee lake 125 miles northeast of Norway House.

The area has an east and west length through Oxford and Knee lakes of at least 65 miles and may extend southeast another 18 miles from Fishing Eagle lake to the outlet of Gods lake. The greatest known width is 13 miles, although its margin south of the west end of Knee lake has not been explored because of lack of canoe routes.

The flying distance to both Oxford and Knee lakes from the new winter base at Ilford, Mile 286 Hudson Bay railway, is approximately 80 miles. The winter road from Ilford to Gods lake crosses Knee lake and Whitemud lake just north of the east end of Oxford lake from which a road leads to Oxford lake via Peemow lake.

Two canoe routes reach the area. The most travelled route leads from Norway House down Nelson river to the junction

with Echimamish river. En route a portage is made at Sea River falls. Echimamish river is ascended 35½ miles to the divide where the Painted Stone portage, 100 feet long, leads to Hayes river, which is then followed downstream through Robinson, Logan, Opiminigoka and Windy lakes to Oxford lake. Below Robinson lake, a portage 60 chains long is crossed by a pole tram-line. The remaining portages are short. The distance by canoe between Norway House and Oxford lake is approximately 150 miles, with eight portages, and the trip takes from four to ten days, depending upon the amount of freight carried and weather conditions. Knee lake is reached from the east end of Oxford lake by Hayes river in a stretch of 11 miles which includes several portages.

A second canoe route is sometimes used from Mile 214, Hudson Bay railway, up Nelson river to Clearwater river and thence up this river to Clearwater lake. The route crosses Clearwater lake and follows east and southeast across Bear Head, High Hill, Stony and Deer lakes, including stretches of streams and several short portages. A portage, ¾ of a mile long, is then made to Bigstone lake and Bigstone river is ascended to Bear lake. Another portage, ¾ of a mile long, leads into a small lake from which a third portage, 1 mile long, is made into Powstick lake, which in turn is connected by stream with Sucker lake and Sucker river to Oxford lake.

This second route is about 75 miles long. It was first explored in 1923 by R. C. McDonald, Topographical Survey of Canada, who found that it could be easily travelled in three days with light loads. As it makes a direct connection with Hudson Bay railroad it may be more favoured in the future if much travel develops to the Oxford-Knee Lakes area.

Rocks of the Area

The Oxford-Knee Lakes area is the largest of Hayes River and Oxford Lake strata in northeastern Manitoba, and also one of the two largest belts of basic Precambrian lavas and sediments in the Province.

The first information on the geology of the area was obtained by Robert Bell, who explored Hayes river for the Geological Survey of Canada in 1878 and 1879. In 1919 E. L. Bruce mapped and made a detailed study of the geology of Knee

lake and in 1925 J. F. Wright made a geological survey of Oxford lake.

In summarizing his investigations Bruce states: "The character and sequence of the rocks of Knee Lake district are comparable with those of the rocks occurring in districts in which payable ore deposits have been found."

Much of the area is covered by a thick mantle of Pleistocene deposits and rock outcrops occupy a very small percentage of the whole area. Some particular features of the Knee Lake area are given in the following paragraph:

"*Assuming that mineral deposits are associated with igneous intrusions, the rocks bordering the small intrusions of granite southeast of Cinder lake and east of the second narrows of Knee lake are the most likely localities for concentration of metallic minerals. Any of the rocks prior to the granite may possibly contain veins, but the brittle, massive rocks such as the lavas are more likely to contain large and continuous veins than are the soft and heterogeneous sedimentary beds. The quartz veins that have been found to be auriferous occur in fractured quartz-porphyry dykes.*"

In the Oxford-Knee Lakes area rocks of the Hayes River group lie along the north margin of the belt and also along the south margin from near the west end of Oxford lake to 4 miles east of the inlet of Hayes river. From the west end extending through the central part of the lake, Oxford sediments lie between the lavas. They continue eastward but are bordered on the south by granite. Small dykes of gabbro cut the Hayes River lavas near the west end of Oxford lake and a few small dykes of quartz and feldspar porphyry cut the greenstone along the north shore of Knee lake. Small bodies of intrusive rock, however, are not known to be abundant in the Hayes River and Oxford groups of the area, except at a few localities. The lavas and sediments adjoining the granite are only locally recrystallized or otherwise altered by the effects of the granite magma.

Mineral Occurrences

Knee lake was evidently the first part of the Oxford-Knee Lakes area to receive attention from prospectors. Gold is reported to have been first discovered there in 1918. When

Bruce mapped the Knee Lake area in 1919, claims had been staked at two places on the lake; on a point in Painkiller bay and on the east end of Magennis island.

At Oxford lake some work was done over twenty years ago on deposits of iron carbonate at Hyers island. However, the main interest in the lake as a prospecting area dates from 1922 when work was commenced on a mineralized shear zone in greywacke located on the south shore of the lake opposite Cargill (Carghill) island. The occurrence was later staked as the Lynx group of mineral claims. It comprised a belt of chlorite and sericite schist cut by narrow veinlets and small lenses of quartz and massive sulphides, including pyrite, chalcopyrite, sphalerite and galena. The quartz is quite abundant in places, and contains some gold. The schist is thought to be derived from tuff or greywacke; it adjoins andesite on the south and the area of Hayes River rocks is believed to be only a narrow tongue within the large body of granite to the south.

In 1924 claims were staked on a wide belt of schist outcropping at the east end of Hyers island. This body of chlorite talc and sericite schist lies in lavas of the Hayes River group and is mineralized with iron, copper, zinc, lead and antimony sulphides and gold-bearing quartz.

In the autumn of 1928 twenty-two holes were diamond-drilled on a copper-gold deposit at the northeast corner of Hyers island. This deposit lies along the south margin of the schist belt where quartz and chalcopyrite are more abundant than elsewhere.

Large bodies of iron carbonates occur along the schist belt on the north side of Hyers island. Wright states that one of these is at least 3,000 feet long and 50 feet wide.

In concluding the notes on the Oxford-Knee Lakes area, it may be pointed out that in addition to the mineral occurrences already mentioned:

"The Hayes River lavas on the north shore of Oxford lake near the east end of Cargill channel are cut by narrow quartz veins, and some of these contain free gold. All the gold-bearing quartz is at or near the water-level on small islands or points. Some quartz float carries abundant free gold."

REFERENCES

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"Knee Lake District, Northeastern Manitoba;" Geol. Surv., Canada, Sum. Rept. 1919, pt. D, pp. 1-11.

Wright, J. F.:
"Oxford and Knee Lakes Area, Northern Manitoba;" Geol. Surv., Canada, Sum. Rept. 1925, pt. B, pp. 16-26.
"Oxford House Area, Manitoba;" Geol. Surv., Canada, Sum. Rept. 1931, pt. C, pp. 1-25.
"Geology and Gold Prospects of the Areas about Island, Gods, and Oxford Lakes, Manitoba;" Bul. Can. Inst. Min. and Met., No. 244, pp. 440-454 (August, 1932).

BIGSTONE AND FOX RIVERS AREA

The Bigstone and Fox Rivers area includes the country traversed by Bigstone and Fox rivers from Bigstone lake to Hayes river. It has a length of about 100 miles in a north-easterly direction from Bigstone lake which lies about 20 miles north of Oxford lake. The area is flat-lying and deeply covered with drift except along the waterways. It can be reached by canoe from Oxford lake or Mile 214, Hudson Bay railway, by following the second canoe route to the Oxford-Knee Lakes area (see Oxford-Knee Lakes area).

Merritt lists three main bands of volcanic rocks and two bands of sedimentary rocks in the area traversed. Volcanics and sediments outcrop at Bigstone lake. A second band of volcanics crosses Bigstone river 15 miles below the lake and a third band follows Fox river for a considerable distance.

A serpentine rock extends for a mile along the shore of Fox river about 6 miles below Bigstone river. The second band of sediments outcrops along the lower stretches of Fox river for a distance of 25 miles.

Pegmatite dykes occur on Bigstone lake and diabase cuts the lavas on Bigstone lake and the granites on the river above the lake.

REFERENCES

Merritt, C. A.:
"Bigstone and Fox Rivers Area, Northern Manitoba;" Geol. Surv., Canada, Sum. Rept. 1925, pt. B, pp. 27-30.

(Reference page 60)

Bigstone lake which lies 20 miles north of Oxford lake should not be confused with a lake of the same name which lies 15 miles west of the south end of Island lake.

CROSS–PIPESTONE LAKES AREA

The Cross-Pipestone Lakes area lies about 60 miles north of Lake Winnipeg. The area has for its northern and southern boundaries approximately latitudes 54 degrees, 51 minutes, and 54 degrees, 24 minutes, respectively; in an east and west direction it includes ranges 1 to 5 west, and range 1 east of the Principal meridian.

Cross lake may be reached from Winnipeg either by way of Lake Winnipeg and Nelson river or by way of The Pas and Hudson Bay railway. The former is the summer route. The journey from Norway House to Cross lake, a distance of about 60 miles, is made by canoe in one or two days. On approaching Pipestone lake, the narrow, westerly channel of Nelson river is followed.

All the consolidated rocks of the Cross-Pipestone Lakes area are Precambrian in age. Most of the region is underlain by granite and granite-gneiss but a narrow belt of older rocks extends along either side of Pipestone lake and another belt is found on certain of the islands of Cross lake. The strike of the rocks of the Pipestone lake area is northwest, whereas in the Cross lake area it is northeast. Deep erosion has uncovered the granite until only mere remnants of the older rocks, into which it was intruded, are left today.

Greenstone lavas outcrop intermittently all the way from Oxford to Walker lakes; just south of Cross lake, along Carrot river.

In 1929 considerable surface work was done on a group of claims situated on the small islands about 4 miles northeast of the Hudson's Bay post in Cross lake.

REFERENCES

Alcock, F. J.:
"Cross-Pipestone Map Area, Manitoba;" Geol. Surv., Canada, Sum. Rept. 1919, pt. D, pp. 11-18.

HERB LAKE AREA

The Herb Lake area surrounds Herb (Wekusko) lake, which is situated 12 miles north of Mile 81, Hudson Bay railway, and is usually understood to include several small neighbouring lakes such as Squall, Herblet, Snow and Tramping, along which claims have been staked at one time or another, during the past twenty years.

The area is easily accessible and is reached from The Pas over the line of Hudson Bay railway to Mile 81 and then north 12 miles over a well-kept motor road to the south end of Herb lake. During the summer months a launch service is maintained between the south end of the lake and Herb Lake settlement on the east side of the lake and 12 miles to the north. During the winter months horses and sleighs are used from Mile 81 to Herb Lake.

Rocks of the Area

The area was first noted as prospecting territory by J. B. Tyrrell during his exploration of Grass, Nelson and other rivers of northern Manitoba and Saskatchewan during 1896. In his report, published in 1900, he described in some detail the schisted Precambrian lavas and sediments surrounding the lake and also mentions the occurrence of quartz veins.

The greater part of the Herb Lake area is underlain by a complex of igneous and sedimentary rocks of Precambrian age intruded by bodies of quartz porphyry, quartz gabbro and granite. Kisseynew sedimentary gneisses occur north of Herb lake and around the northern part of Herblet lake.

A belt of Palaeozoic dolomite extends across the south margin of the Herb Lake area. Some lavas are grey, porphyritic and non-porphyritic rhyolite; others are black andesite and basalt. Interbedded with the lavas are slate, greywacke, arkose, conglomerate and quartz-mica gneiss. Dykes and small bosses of mica and hornblende lamprophyre are abundant in the rhyolitic lavas east of Herb lake.

Mineral Occurrences

To cite a few examples of mineral occurrences, the quartz veins of the Rex, Bingo, McCafferty and Dauphin-Elizabeth properties are in rhyolitic lavas at or near their contact with

sediments. The vein on the Moosehorn and Ballast claims is in a lamprophyre dyke and the veins on the Kiski property are mostly in a body of quartz-mica diorite which intrudes the lavas. At the Ferro property the vein system lies in a dark andesitic lava, some phases of which are porphyritic.

Attention should also be directed to the type of deposit found on the Apex group of mineral claims. Shear zones in altered granite have been mineralized with pyrite, arsenopyrite, chalcopyrite and gold. While the gold values are low (average 0.20 oz. gold per ton), it is possible that if sufficient tonnages could be blocked out in deposits of this type, the rock could be economically exploited.

The Rice Island copper-nickel deposit occurs in a medium-grained black or greenish black quartz gabbro of massive appearance. The principal mineralization is in rock that is schistose, jointed and brecciated. It is exposed at the south end and along the west shore of Rice island. Quartz gabbro does not outcrop on the neighbouring islands east and west of the deposit; nor, apparently, does it extend far under the lake beyond the island as most of the drill cores passed through quartz gabbro into the surrounding greywacke, slate and chlorite and talcose schists.

The north shore of Herb lake is also interesting in that it contains considerable areas of mineralized medium- to coarse-grained quartz gabbro containing values in nickel and copper. Exposures of this rock outcrop on the Copper Dome, Arctic, West, Chalco and Mundic groups of mineral claims on most of which considerable trenching has been done. In most of the showings the combined nickel-copper content is low, in some places reaching 4 or 5 per cent over narrow widths.

In 1929, diamond drilling was done at the Ruby silver-lead property situated a few miles west of the north end of Herb bay. The deposit is in quartzite and thin beds of mica gneiss cut by small bodies of quartz and pegmatite. High values in lead, silver and zinc were obtained in trenching. The mineralized zone contained pyrrhotite, pyrite, arsenopyrite, chalcopyrite, sphalerite and galena.

Several pegmatite dykes are reported to occur in the area bearing considerable quantities of lithium minerals, principally spodumene, although lepidolite, amblygonite and triphylite

have been reported. Masses of beryl have been taken from some of these dykes.

A notable occurrence of the lithium mineral, spodumene, was discovered near Crowduck bay in 1931.

Occurrences of molybdenite had also been noted on Crowduck bay, on Grass river near the outlet of Herb lake, and on the north arm of Herblet lake. Galena and sphalerite were also reported to occur in a quartz-impregnated shear zone in greenstone on the south shore of Snow lake.

Early Developments

Herb Lake holds the distinction of being the first area in which gold was discovered in northern Manitoba and the first to operate a gold-milling plant in the Province.

In 1914 as the result of reading Tyrrell's report, M. J. Hackett and R. Woosey entered the area on a prospecting trip and soon made a discovery of gold on the east shore of Herb lake.

Early in 1915, the Rex vein was discovered and by April 16, 1915, The Pas "Herald and Mining News" reported that 350 claims had been staked in the Herb Lake area.

Moosehorn and Ballast Claims. — In November, 1916, development was commenced at the Moosehorn and Ballast claims on the east shore of Herb lake. In 1917 a shipment of 57,000 pounds of ore was made to Trail, B.C., and yielded $2,323, the first production of gold from quartz ores in Manitoba.

A copper-nickel deposit was staked in 1917 on Rice island near the west shore of Herb lake. This was diamond drilled in 1928 and 1929.

During the same period considerable surface work and diamond drilling were also done on a copper-zinc sulphide deposit at the southwest end of the lake.

Rex Mine.—By April, 1918, considerable underground work had been done at the Rex property. A 40-ton Lane mill was installed, and put into operation early in May. The first goldbrick was shipped in June. Operations were discontinued in November after a production of 1,337 ounces valued at $27,368 had been made.

Underground work was resumed at the Rex in 1920 and small productions of gold were recorded for 1920 and 1921. After a period of inactivity the mine was sampled in October, 1923, and operated during 1924 and 1925, producing 1,131 and 4,424 ounces of gold respectively in the two years. Two shafts, one 425 feet and one 100 feet deep, were sunk on the property.

The mine was inactive from November, 1925, until the fall of 1934 when interest in the Herb Lake area was renewed.

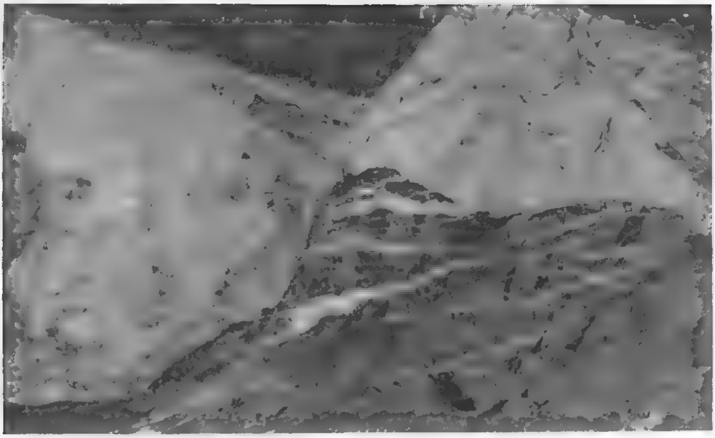
Laguna Mine.—Since 1934 considerable development work has been done on the Laguna (Rex) property. The old incline shaft has been extended to the 625-foot level and a vertical shaft has been sunk from the 500- to the 750-foot level. Much lateral work has been done on three new levels, the 500-, 625- and 750-foot. Encouraging results have been obtained on several sections of the new workings.

The ore-body at the Laguna mine property consists of a sugary-textured quartz vein that is locally well mineralized with arsenopyrite, pyrrhotite and gold, with sparing amounts of chalcopyrite and galena. Most of the gold values appear to be associated with the arsenopyrite mineralization. The vein follows rather closely the contact between a lamprophyre dyke which cuts an intrusive stock of quartz porphyry (rhyolite). To the north the vein material passes into the foot-wall sediments (arkose and conglomerate). Small fault displacements have been noted in the vein but none of these exceeds 5 or 6 feet, so that little difficulty has been encountered in locating the continuation of the vein.

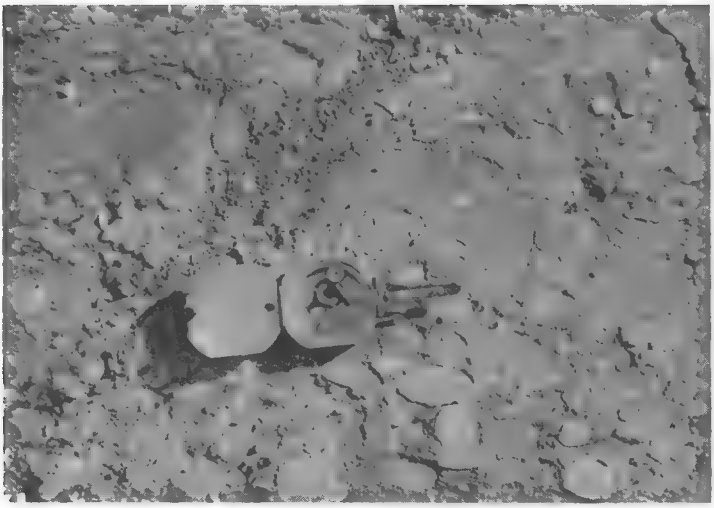
Bingo Mine.—Considerable underground work was also done on the Bingo property at intervals during the period of 1919 to 1927. A shaft was sunk to a depth of 400 feet and levels opened up at 100, 200, 300 and 400 feet. The total production of gold from the property, however, was less than $10,000.

Ferro Mine.—During 1932 about $12,000 in gold was produced from a quartz lens on the Ferro claim.

It should be emphasized that there is still room for careful prospecting in the Herb Lake area. Throughout the last twenty years there have been continuous discoveries of new deposits whose variety of type testifies to the widespread mineralization in the area as a whole. Gold values in veins appear to be confined



Fault displacement across quartz vein 625-foot level
Laguna Gold Mine, Herb lake.



Foot-wall conglomerate, Laguna Gold Mine, Herb lake.

entirely to the quartz, very little following mineralization into the wall rock. *The existing gold prices make many of the narrower types of vein deposits exceedingly interesting in this as in many other areas of the Precambrian.*

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REED LAKE AREA

The Reed Lake area surrounds Reed, Morton, File, Loonhead and Woosey lakes. Reed, the largest lake, one of the expansions of Grass river, lies about 25 miles due west of the south end of Herb lake, and about 35 miles due east of Cranberry Portage on the Manitoba Northern railway (The Pas-Flinflon).

The area is reached by canoe from Cranberry Portage via the Cranberry lakes, Elbow lake, Iswasum lake, Loucks lake and intervening stretches of Grass river. Six short portages are made en route. The trip takes from one to two days' easy travelling.

A second route leads from Herb lake up Grass river via Tramping lake to Reed lake. Two portages, one 23 chains, and the second 15 chains, are crossed during the trip which takes but a few hours. A wagon road, 4 miles long, leads from the most northerly tip of Reed lake to Morton lake. A short portage leads from Morton lake into File lake and File river leads into Loonhead lake. Woosey lake may be reached by ascending a stream that empties into the east bay of Reed lake.

Rocks of the Area

While Ordovician limestone overlies most of the area south of Reed lake, Precambrian lavas outcrop to the west and north of the lake and extend as a belt several miles wide both east and west of Morton lake to File lake and the south shore of Loonhead lake. The lavas also extend eastward from Morton lake through Woosey lake to the shores of Tramping and Herb lakes. The lavas include rhyolite, basalt and andesite with intercalated tuff, chert, and carbonate beds. Dykes of pegmatite, granite, granite porphyry, gabbro and black lamprophyre cut the lavas. Wide zones of chlorite schist have been developed in some localities.

Sediments outcrop north of File lake and north and west of Loonhead lake and extend through Limestone Point and Walton lakes to the Kississing Lake area. They are grey and black quartz-mica gneisses of the Kisseynew series.

Mineral Occurrences

The Reed Lake area has been prospected at intervals for over twenty years, with the greater part of the activity being confined to the last eight or ten years. Claims have been

staked and work done upon gold-bearing quartz veins and sulphide deposits.

The best known of these are the gold-quartz veins of the North Star and Gold Shower groups located about 6 miles west of Morton lake. The veins occur in belts of chlorite schist in a massive, black, medium-grained andesite about a mile east of its western contact with the granite. Pyrite, chalcopyrite, sphalerite and galena occur sparingly in the quartz. Free gold is sporadic in its occurrence.

Since 1927 when the original deposit was discovered considerable development work has been done on the property by various interests.

According to Wright,

"The wide belt of volcanic rocks surrounding the North Star deposit and extending northward from the west end of Reed lake appears to be a promising area wherein to prospect intensively for gold-bearing deposits."

In 1928 and 1929 claims were staked at Loonhead lake and at Jackfish lake just north of the centre of Reed lake. On Loonhead lake the deposits occur as mineralized zones containing pyrrhotite, pyrite and a little chalcopyrite in mica gneisses and schistose andesites. At Jackfish lake sulphide bodies occur in a quartz gabbro.

Work has also been done on several quartz showings that occur in lavas outcropping on the south shore. *Prospecting should be centred in those areas where schistose belts of lava are intruded by small bosses of granite and granite porphyry.*

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ELBOW LAKE AREA

Elbow lake, an expansion of Grass river, lies about 30 miles northeast of Cranberry Portage on the Manitoba Northern railway (The Pas-Flinflon).

The canoe route to the area traverses the Cranberry lakes and a 6-mile stretch of Grass river. The only portage is over a one-mile wagon road from Cranberry Portage to First Cranberry lake. The trip is usually made in five to six hours by canoe and outboard motor. Because of its location on one of the well-travelled water routes of the north, Elbow lake has been visited by many prospectors.

Rocks of the Area

The area of lavas and schists on and about the lake is about 6 miles wide and 12 miles long. The volcanic rocks include flows of andesite, diabase and basalt together with intercalated beds of tuff-like materials. Hornblende, chlorite and sericite schists were developed by shearing of the lavas and tuff-like beds and occur in wide areas. Granitic rocks in small bosses and dykes cut the lavas and have, for the most part, developed gneissic and schistose structures.

Mineral Occurrences

The mineralized deposits occur as zones of granitic rock with andesitic inclusions made schistose by shearing and cut by numerous stringers and lenses of quartz. They are mainly in a basic marginal phase of the granite near its contact with andesitic lava. Some of the quartz stringers carry abundant free gold.

Early Developments

Some claims are reported to have been staked on Webb creek at the north end of the lake as early as 1916, but it was not until gold was discovered at the south end of the lake in 1920 that the main activity commenced. The Murray group of mineral claims is located on Grass river at the outlet of Elbow lake. In 1921 considerable surface work was done on this group, including trenching, two prospect shafts, 25 and 60 feet deep, and 50 feet of drifting before operations were suspended. Additional work of an intermittent nature has been carried on from time to time.

Other properties that have been prospected extensively by trenching and prospect shafts are the Sherlock, Webb-Garbutt,

Mack and Hanna. Most of these occurrences are in shear zones in andesitic schists. Many other deposits are known in the area. Detailed descriptions of individual properties in the area may be obtained from Stockwell's report referred to in the References.

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CRANBERRY, COPPER AND BRUNNE LAKES AREAS

The three Cranberry lakes extend northeast from Cranberry Portage for a distance of about 20 miles. Copper and Brunne lakes lie north of Second Cranberry lake and within 4 miles of the Sherridon branch of the Manitoba Northern railway. Both winter and summer routes to the latter lakes leave the railway at Mile 12.

Rocks of the Area

Belts of Amisk lava of rather restricted extent form the attractive prospecting ground of the area. The lavas are cut by granite, granite porphyry and pegmatite. Recrystallization of the dense volcanic rocks to rocks possessing a much coarser grain appears to have taken place along the margins of the intrusive granite. *Tuff-like bands of sedimentary rock are included within the volcanic series and should be prospected carefully, especially where fine-grained dykes of granite porphyry are seen to intrude this type of formation.*

The largest belt of Amisk formation with a maximum width of 3 miles lies to the north of the narrows between Second and Third Cranberry lakes. Another belt of rather limited extent surrounds Copper and Brunne lakes.

Mineral Occurrences

Attention has been directed by Wallace to the type of sulphide mineralization found in the vicinity of Copper and Brunne lakes. "Some idea of the extent of this iron sulphide mineralization may be obtained from the fact that on the Caribou claim west of Brunne lake a rounded hill is well exposed on the line of strike of the iron formation at least 75 feet wide and is mineralized throughout with practically solid pyrite and pyrrhotite." The sulphide bodies are reported to contain some gold, copper, nickel and platinum.

Gold occurs in quartz veins in association with sulphide minerals. The most important development has been that on the Dominion group of claims (Gurney Gold Mines) between Copper and Brunne lakes. The gold values of this property occur in a sheared tuff-like band in the volcanic rocks. The vein has been developed by the replacement of much of the sheared tuff by quartz and consists of a mosaic of rock fragments and stringers of blue quartz. The mineralization consists of abundant pyrite, some galena and chalcopyrite and gold. The vein is irregular in width but strikes north 42 degrees east and dips 75 degrees to the northwest.

Prospectors in this area should be cautious as to the reliability of panning tests for gold values. It has been noted that where the gold is very finely divided only about one-third appears in the pan. With existing gold prices, important showings may be neglected if only the panning method of estimation is used.

The area was one of the first to be visited by prospectors in northern Manitoba and it has been prospected at intervals ever since. Many of the mineral occurrences were known for several years before 1928 but it was not until that year that the first attempts at development took place. In 1928 some diamond drilling was done on a deposit of chalcopyrite in small shear zones north of Cranberry Portage and a sulphide body near the northeast end of Second Cranberry lake was also explored. The latter deposit which was discovered in 1928 consists of some chalcopyrite distributed through pegmatite and adjoining lavas.

In 1928 and 1929 considerable surface work was done on a number of sulphide bodies near Copper and Brunne lakes and some of these bodies were diamond drilled.

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ATHAPAPUSKOW LAKE AREA

The Athapapuskow Lake area lies mainly along the north shore and around the north arm of lake Athapapuskow. It includes the basins of Neso, Nisto, Payuk, Twin and Thompson lakes and the belt of schists which extends along Pineroot river to Mikanagan lake. The approximate limits of the area are latitudes 54 degrees, 30 minutes, to the south, and 54 degrees, 50 minutes, to the north and the Manitoba-Saskatchewan boundary to the Cranberry Portage-Sherridon branch of the Manitoba Northern railway west to east.

The Flinflon branch of the railway parallels the north shore of the main lake for 18 miles and during the summer months prospectors leave the railway either at Cranberry Portage, Mile 51, where supplies and equipment can be secured, or at Athapap, Mile 66, which is the closest railway point to the north arm and west end of the lake.

Rocks of the Area

Owing to its location on one of the principal canoe routes north of The Pas, Lake Athapapuskow has been crossed and recrossed from the earliest times. Tyrrell noted the occurrence of Precambrian schists along the shores of the eastern part of the lake in 1896 and Dowling describes in detail the geology of the North Arm and Pineroot River areas which were mapped during his trip to Kississing and Churchill rivers in 1899. Being the closest Precambrian area to The Pas it was probably one of the first to be looked over by prospectors in northern Manitoba.

The promising ground for prospecting in the Athapapuskow lake area consists of Amisk volcanics and Missian sediments which have been metamorphosed largely into schists. The volcanics include black and green andesite and grey rhyolite. Large areas are altered to an aggregate of chlorite, sericite, epidote

and carbonates. The lavas are porphyritic in places and may be interbedded with agglomerates and coarse pyroclastic beds. The Missian sediments are metamorphosed conglomerate, arkose and greywacke. Both lavas and sediments are cut by later intrusions of granite and granodiorite. *The larger of the schist areas comprising the most promising prospecting field, surrounds the north arm.*

Mineral Occurrences

During the period of 1915 to 1920 the area received some careful prospecting, and many sulphide bodies were discovered on Pineroot river, on the east arm of Lake Athapapuskow, at Twin lake, and at Thompson lake. Considerable work was done on several of these bodies and near the mouth of Pineroot river the Chica claim was explored by diamond drilling during the summers of 1918 and 1919. According to Wallace:

"The characteristic of this district is the widespread occurrence of chalcopyrite and bornite in bunches, stringers and isolated crystals in schisted bands in the greenstone . . . . while only occasionally in the district have quartz veins been discovered with indications of gold values."

Early Developments

In 1922 the Baker-Patton copper-sulphide deposit, situated at the extreme north end of Sourdough bay, a northeast branch of the north arm of Lake Athapapuskow, was held for a short time under option.

In 1926 and 1927 five holes averaging 400 feet in depth were diamond drilled on the deposit. During 1928 a development plant was taken in from The Pas and a three-compartment shaft was sunk to a depth of 418 feet, cutting stations at the 150-, 275- and 400-foot levels. A total of 630 feet of drifting and crosscutting was done at these levels. Operations were suspended in December, 1928. During the winter of 1929-30, 4,799 feet of diamond drilling were done on this deposit.

The Baker-Patton deposit is in a belt of cherty and tuff-like rocks lying between thick flows of schistose acidic lava. The main sulphide zone consists of black slaty ash-like rocks and chloritic schists which are heavily impregnated with pyrite and small quantities of chalcopyrite.

Twenty-eight hundred feet of diamond drilling were done on a group of claims between Sourdough bay and Thompson

lake and in 1929 a deposit on the Don Jon mineral claim was diamond drilled. The latter deposit is on an island in Thompson lake, and consists of sulphides along limy beds between thicker, more massive quartzose chlorite-carbonate schists which probably represent beds of quartzose and limy sediments within the lavas. At the south end of the island the sulphide-bearing zone is about 50 feet wide but it narrows to the north. Considerable chalcopyrite is present in some parts of the deposit.

Late in 1929 the Billy Boy group, situated near Mink Narrows, North Arm, was optioned, following a discovery of gold on one of the claims. The property was carefully prospected during 1929 and 1930. Gold was found to occur in quartz stringers up to 4 inches in width in a basic granodiorite which is intrusive into the lavas. The granodiorite which is slightly sheared along joint planes carries pyrite and a little chalcopyrite in places along the shear zones. In 1931 some diamond drilling was done on the deposit but no workable ore-body was brought to light by the exploration work.

Some trenching was done in 1930 at the Var group on an outcrop of sulphide-bearing schist which appears on a small island to the southeast of the Billy Boy claims. Widths up to 10 feet assayed about 2.5 per cent copper. The deposit could not be trenched for any distance, however, because of its proximity to the water's edge. Diamond drilling would be necessary to determine the continuity of the body under the lake.

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SCHIST–FLINFLON LAKES AREA

The Schist-Flinflon Lakes area comprises a belt of Precambrian rocks which extends along the Manitoba-Saskatchewan boundary from the seventeenth base line northward for a distance of about 20 miles. It includes the basins of Schist, Ross, Flinflon, Embury and Tartan lakes, and lies mainly in townships 65-68, range 29, west of the Principal meridian.

The area is easily reached from the Flinflon branch of the Manitoba Northern railway which runs along the east shore of the northwest arm of Schist lake, the east shore of Ross lake and terminates at the town of Flinflon on Flinflon lake, about 87 miles by rail north of The Pas.

Rocks of the Area

The rocks exposed in the area are for the most part Amisk volcanics which are interbedded with thin layers of sediments and are cut by small bodies of gabbro, granodiorite, granite and granite porphyry. All the volcanic rocks are more or less schistose and some have been altered to chlorite schists by extreme metamorphism.

Mineral Occurrences

Many sulphide bodies are found along the contacts of small granite intrusions with the chloritic greenstone and greenstone schist. In such bodies the sulphides are chiefly pyrrhotite or pyrite but none has been found to contain enough nickel or copper to make it important. *The valuable lenses lie some distance from outcrops of igneous rocks but not too far from actually exposed bodies to make their genetic connection with the intrusions seem improbable.*

The area contains two notable ore-bodies, the Flin Flon and Mandy copper-zinc sulphide deposits. Both were discovered in the early days of prospecting in northern Manitoba and both have made significant contributions to its mining history.

News of the Flin Flon discovery did not reach far until late in 1915. It attracted a number of prospectors to the immediate area and led to the discovery of the Mandy ore-body by Fred Jackson and Sidney S. Reynolds in October of the same year.

The Schist-Flinflon Lakes area has been prospected at intervals ever since the original discoveries were made and a

The Mandy, Manitoba's first important producer of metals.
Schist Lake, 1916

number of other sulphide bodies have been found and staked in the vicinity of the north and northeast arms of Schist lake and east of Ross lake. Perhaps the best known of these are the Thompson-Paull group on the northeast arm of Schist lake and the Iron Horse group on the Manitoba Northern railway at Mile 78. Considerable trenching has been done at the latter property.

In the northeastern part of the area a few prospectors have been actively engaged in exploring gold prospects at Tartan lake. During 1932 a number of claims were staked in this area and several shipments of gold-quartz ore were sent to the smelter at Flinflon from one of them, the Ruby mineral claim.

Mandy Mine.—The Mandy was the first deposit in the entire area to undergo development. It was optioned soon after discovery and was diamond drilled in the summer of 1916. Incidentally, this was the first diamond drilling done in northern Manitoba and revealed an ore-body containing 25,000 tons of massive chalcopyrite averaging about 20 per cent copper and containing gold and silver to the value of about $5.00 per ton, together with an additional 180,000 tons of lower grade ore containing 5 to 8 per cent copper, 20 to 30 per cent zinc and gold and silver to the value of $5.00 per ton.

Owing to the high price then prevailing for copper, it was decided to mine and ship the massive chalcopyrite ore by a combination of team haul, water transportation and rail to the smelter at Trail, B.C. During the period of 1917 to 1920 inclusive, there was mined and shipped about 25,000 tons of ore, which produced 9,866,328 pounds of copper valued at $2,039,943, with additional values of $5.00 per ton in gold and silver.

An extensive campaign of underground development was carried on at the property in 1928 and 1929. The shaft was deepened to 1,025 feet, with levels below the old workings at 100-foot intervals from 325 feet down. Lateral work was done at all levels and, in addition, considerable diamond drilling from underground stations. Operations were suspended late in 1929 to await better prices for copper.

The Mandy deposit is in a band of schist with massive greenstone on either side. It is 225 feet long and has a maximum width of 40 feet. It dips from 75 to 80 degrees to the east,

and pitches at a high angle to the south. The chief minerals are pyrite, which is the most abundant, sphalerite and chalcopyrite in important quantities, and minor amounts of galena and arsenopyrite. Gold and silver contribute important values.

Flin Flon Mine Discovery.—The Flin Flon ore-body was the first discovery in the area. Because of the importance of the Flin Flon mine the story of its discovery is offered in some detail.

The find was made in the winter of 1914 just before Christmas by Thomas Creighton who had a camp at the time on Phantom lake a few miles south of Flinflon lake. He was one of a party of six men prospecting in the Beaver Lake area for John Hammill and associates. Four of the party, Leon Dion, the two Mosher brothers, and Creighton, combined trapping in the winter and prospecting in the summer. Leon Dion was camped in the neighbourhood and the Moshers were in the Beaver Lake area.

On the day of the discovery, Creighton was circling through the country looking for fur signs, sizing up the rock formations and hoping to see a moose that he could shoot for fresh meat. His wanderings took him in sight of the lake (there were then no maps of the country) and he went down to its shore. On a point where there was an outcrop the snow had been blown clear enough to show chalcopyrite in the schist. Creighton saw the mineralization and decided that it was worth further examination.

When the snow was gone in the spring of 1915, Creighton returned for that purpose in the company of Jack Mosher. Together they decided that the prospect was worth staking, and on August 15, 1915, after a further examination, they staked the first two claims. The pair then went over to Beaver lake where the other members of the party, Dan. Mosher, the two Dion brothers and Dan. Milligan, were located. After staking sixteen claims the party informed Hammill, who was at Beaver lake, of the find.

Early Developments at Flin Flon Mine.—Hammill examined the property and subsequently interested Hayden-Stone, Boston, Mass., and associates, with the result that further exploration work, including diamond drilling, was soon under way.

During 1916, 6,000 feet of diamond drilling were done on the property in an attempt to estimate the main ore-body but

Mandy Mine from the air
Schist Lake
1930

agreement with the owners as to terms was not reached, and work was suspended. In 1917 the Fasken interests of Toronto commenced diamond drilling and continued until July, 1918, drilling in all 44 holes, representing a total of 25,664 feet. At this stage the possibility of recovering zinc values was problematical. In 1920, R. E. Phelan came to Flinflon to study direct smelting of the ore. At the same time underground development was carried on, totalling 1,892 feet of sinking, crosscutting and drifting, for the purpose of test-sampling the ore and to confirm the diamond drilling results.

In November, 1925, Mining Corporation of Canada interested Minerals Separation Company, representing the Whitney interests of New York, with R. H. Channing, Jr., conducting the negotiations. Metallurgical experimentation was carried on until 1928 and when a satisfactory process for extraction of the metals was worked out, Hudson Bay Mining and Smelting Company, Limited, was incorporated to develop and operate the Flin Flon mine.

A railway was built by the Manitoba Northern Railway company with the assistance of the Government of Manitoba in the form of guarantees, from The Pas to Flinflon, a distance of 87 miles. Steel reached Flinflon in October, 1928, and furnished the means of transportation for great quantities of construction material, equipment and supplies to that point for the mining and metallurgical plants, and also for a hydro-electric plant to be constructed at Island falls on Churchill river, 56 miles to the north. During the winter of 1928-1929, 25,000 tons of material were hauled by sleighs and Lynn tractors over 69 miles of iced winter roads to the power site where, until July, 1930, 800 men were employed in the construction work.

At Flinflon, excavation work to the east and northeast of the ore-body was started early in 1929, and the end of the year saw completion of most of the foundation work for the hoisting and crushing plants, flotation and cyanide mill, zinc roasting, leaching and electrolytic plants, copper smelter, power houses, bedding bins and coal-pulverizing plants. Together with these, extensive preparations were made for mining both in open-pit and underground. As a considerable part of the ore lay beneath a bay at the southeast end of Flinflon lake, plans were made to dam off this bay and pump out the

water. A five-compartment main shaft, 15- by 22-feet excavation, was started centrally along the ore-body at a location 400 feet to the east of the hanging-wall.

A transmission line from Island falls to Flinflon was completed early in 1930 and made hydro-electric power available for testing and operating the various plants. By December, 1930, after plant adjustments had been made, the regular production of blister copper was started. Early in 1931 a daily mine tonnage of 3,000 tons of ore was attained. This rate was maintained until about June, 1932, when the daily mine output was stepped up to 4,400 tons.

Flin Flon Ore-body. -According to Brownell*, much of the Flin Flon ore-body, and perhaps all of it, lies in sheared quartz porphyry which occurs presumably in the form of a dyke between beds of steeply-dipping andesitic lavas and other volcanic rocks of the Amisk series. The sheared porphyry especially on the foot-wall side has been largely replaced by chlorite to form chlorite schist, or even massive talc, or it has been silicified. In this manner much of the quartz porphyry has been destroyed or replaced to such an extent that the resultant rock bears no resemblance to the original porphyry.

The ore-body is a fairly regularly shaped lens tapering gradually to the northwest and ending rather bluntly to the southeast. It strikes 30 degrees northwest and dips 60 to 70 degrees northeast. The boring records show that it plunges at a low angle to the south. The total length of the ore-body on the surface is 2,593 feet, and its greatest width near the surface, with some inclusions of greenstone, is 400 feet.

The original ore-body blocked out to a depth of 900 feet was estimated to contain 18,000,000 tons, averaging—copper 1.71 per cent, zinc 3.45 per cent, gold 0.074 ounces, silver 1.06 ounces.

In slightly over five years' operating, developments at the Flin Flon mine have reached a depth of 2,210 feet. During this time the mine has yielded some 7,500,000 tons of ore and at the end of 1935 shows ore reserves of 24,770,000 tons which is an increase of 6,770,000 tons over the estimates of 1929. A comparison of the estimated values will also show an increase

*G. M. Brownell, Assistant Professor of Economic Geology, University of Manitoba, personal communication.

Camps No. 2 Shaft Test Mill Power Plant *Courtesy R.C.A.F.*

Aerial View of Early Development at Flin Flon Mine, 1928

in the metal content. The report gives this as: copper 2.10 per cent, zinc 3.86 per cent, gold 0.08 ounces and silver 1.28 ounces.

The minerals in order of abundance are: pyrite, sphalerite and chalcopyrite. Gold and silver occur, apparently associated with the pyrite. Cadmium, selenium, tellurium and cobalt also occur but in lesser amounts. The ore comprises two types, the one a solid sulphide, and the other a disseminated sulphide, with the former assaying higher in zinc and gold but lower in copper than the latter.

Surface Oxidation.—An extremely noteworthy description of the surface oxidation of the Flin Flon ore-body has been made by Brownell and Kinkel and as it is the oxidized zone that first attracts the prospector, the description of the occurrence may be quoted in full:*

"Oxidation was confined to within a few feet of the surface, where the only concentration of values took place. There has been little indication of any underground circulation of water, although there are numerous joints and fractures traversing the ore. Lack of oxidation underground is attributed to the cold condition of the surface water which, during fully half of the year, is in the form of ice. In fact, it is quite probable that much of the muskeg and clay overlying the ore remained frozen through the year, thus minimizing the amount of water free to circulate.

"Another factor tending to prevent surface weathering was the blanket of thick beds of fine, black, rubbery lake and glacial clays that immediately overlay much of the ore. This acted as a more or less impervious layer and only at one place, the original discovery point, did the sulphide body penetrate this clay. Here the ore was thoroughly oxidized and contained important concentration of gold and silver. This oxidation is thought to be post-Glacial, as the oxidized area was in an elevated and exposed position; had it been pre-Glacial, it is difficult to conceive how such a soft mass could escape being scraped down level with the enclosing rock. The rock and solid sulphide enclosing this small oxidized area were highly polished and striated by glacial action; even the depression scooped out of the ore by the glacier several hundred feet to

*A. R. Kinkel, Jr., Geologist, Flin Flon Mine.

the southward, and which is 80 to 100 feet lower in elevation, displayed a striated and unoxidized surface.

"The oxidized area was carefully mapped and sampled because of its high gold and silver content. It was found to consist of fairly regular layers, yellow, red, white, and purplish in colour, and composed of limonite, quartz, and clayey material. In thickness this ranged from one to ten feet and it was generally overlain by one or two feet of sandy muskeg. Pits dug in this area revealed, in some places, a fairly sharp contact between the solid sulphides and oxidized material, but generally the contact was found to be gradational from the clayey limonite to solid sulphides. The transition zone was soft and sugary, grading into normal, hard, solid sulphide within two or three feet.

"The gold content of the oxidized zone was for the most part uniform, and the soft transition zone carried high values for a foot or two below the clay. Some of the yellow clay carried no gold, however, though it could not be differentiated by visual inspection from that which did; but subsequent churn drilling revealed that such barren areas were underlain by disseminated ore which carries no gold values. Sampling showed that only over the solid sulphide did the oxidized zone carry gold and silver, proving very definitely that concentration of values was the result of residual enrichment. Proceeding along the strike to the north and to the south from the outcrop, the oxidation extended for distances varying up to one hundred feet beneath the clay, with values decreasing as the thickness became less. *As a matter of interest to prospectors, it may be noted that tests made on the oxidized material revealed that only 15 to 20 per cent of its gold content could be recovered by panning, a result due presumably to the extreme fineness of the gold.*

"The copper and zinc in the solid sulphide was almost entirely removed by oxidation, and the leached sulphides for several feet below the clay carried no copper or zinc. There was only a partial concentration of values lower down, forming a zone of enrichment, because the solutions could not penetrate the massive sulphide ore; but wherever bands of talc occurred in the sulphides, or over the disseminated ore, there was a considerable chalcocite enrichment, up to 20 feet in thickness. No secondary zinc minerals were noted.

Surface Plant, Flin Flon Mine
Hudson Bay Mining and Smelting Company, Limited
1935

"In addition to the chalcocite enrichment of the talc-chlorite bands, some of the copper removed was deposited as native copper in dendritic form in cracks within the blocky, unsheared, waste-horse masses and in the hanging-wall, but not along shear planes. In the black clay above the ore there was a small amount of a mineral which appeared to be cuprite and which occurred as small, round, red spots in the clay, generally about one-eighth to one-quarter of an inch in diameter. Under the microscope, these were found to have a radial fibrous structure similar to that observed elsewhere in cuprite crystals in gypsum and clay. Gypsum was abundant in the clay, forming divergent clusters of crystals up to 8 inches in diameter.

"The lead was also concentrated in this zone of enrichment, assays as high as 3½ per cent being obtained.

"A comparison of the assay of the oxidized material and of the 20-foot thickness of massive sulphide immediately below showed that the oxidized zone carried approximately nine times as much each of gold, silver, and lead, as was present in the underlying sulphides."

The name "Flin Flon" was derived from a character in a book, "The Sunless City," which Creighton, Leon Dion and the two Moshers had found on a portage while travelling from Churchill river to Lac la Ronge in the summer of 1913.

For a full description of the history of development, construction of plant and operations of Hudson Bay Mining and Smelting Co. at Flinflon, Man., and Island Falls, Sask., the reader is referred to the Transactions of the Canadian Institute of Mining and Metallurgy, volumes 33 (1930) and 38 (1935).

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KISSISSING LAKE AREA

The Kississing or Cold Lake area lies due north of The Pas, a distance of about 90 miles. Its southern boundary forms the northern limits of the Schist-Flinflon and Athapapuskow Lakes areas, which are approximately along the eighteenth base line. The area extends northwest to latitude 55 degrees, 30 minutes, north, westerly to the Manitoba-Saskatchewan boundary, and easterly to Takipy, Walton and Nokomis lakes.

The area is reached by the Cranberry Portage-Sherridon branch of the Manitoba Northern railway which terminates at Sherridon. From Kississing lake, long bays reach out to make the greater part of the area easily accessible by canoe. The country southwest of Kississing lake towards Mari lake is low and swampy for many miles, but in the neighbourhood of the lakes in most parts of the area, rock exposures are generally abundant.

Rocks of the Area

The rock types adjoining parts of Kississing lake and Kississing river were first noted by D. B. Dowling during his exploration from Athapapuskow lake to Churchill river in 1899.

By far the greater part of the area is underlain by a thick series of sedimentary gneisses of Precambrian age, which was derived by metamorphism from sandstone, impure sandstone and clayey arkose. The most abundant members of the series are:

A light grey gneissic quartzite which outcrops prominently along the tops of many ridges, and probably originated as beds of sandstone.

Quartz-biotite-garnet gneiss, fine- to medium-grained and greyish in colour. This rock is very abundant and widespread and is probably the metamorphic equivalent of an impure sandstone.

Hornblende-bearing garnet gneiss, a medium- to coarse-grained black rock which outcrops as bands in association with the other two above-described types. It is believed to represent clayey arkose beds originally or volcanic rocks of an intermediate type.

Lavas with sediments occur south of Walton lake and in the basin of Nokomis lake, and andesitic lavas outcrop at

Kisseynew and Fay lakes. A few miles to the east and north of Kississing lake the sedimentary gneisses are terminated by large bodies of granite.

The sedimentary gneisses are intruded by many sills and dykes of granite, aplite and pegmatite and by large batholith-like bodies of granite. A few bodies of peridotite, gabbro and diorite also intrude the gneisses.

Mineral Occurrences

The mineral occurrences of chief interest in the area are pyrrhotite bodies containing chalcopyrite and sphalerite. Of these the Sherritt-Gordon is the most important known deposit and the only one which so far has been developed to any extent. Its ore-bodies occur in a well-defined shear zone in thin bedded quartzite gneiss along the contact with a band of very basic garnetiferous gneiss. The shear zone is more pronounced where the basic band is thickest, and both have been traced for a distance of over 7 miles. Structurally the shear zone is located in the south limb of an overturned anticline, both limbs of which dip to the northeast. The ore-bodies strike northwest and have an average dip of from 45 to 50 degrees. They occur as two elongated lenticular bodies—the east ore-body, having a length of 4,200 feet and an average width of 15.2 feet, and the west ore-body, having a length of 5,800 feet and an average width of 15.5 feet. The ore is a rather coarse-grained mixture of pyrrhotite, pyrite, chalcopyrite and sphalerite, with numerous rock inclusions ranging in size from grains the size of a pea, to blocks weighing several tons.

In the Kisseynew sedimentary gneisses *the sulphide occurrences so far discovered are along local folds or near sharp bends in the direction of strike of the strata and the evidence to date suggests that detailed prospecting should be confined to small local areas either where unusual structures are developed, or where the quartzitic, calcareous and hornblendic varieties of gneiss are exposed.*

Early Developments

The first prospecting in the area was evidently done by trappers. One of these, Phillip Sherlett, a Cree Indian, is reported to have made the first discovery in 1922. White trappers and prospectors staked adjoining ground and, later, all claims were allowed to lapse except a few held by Carl

Sherritt and David Burke. In 1924, Sherlett's lapsed claims were re-staked by Carl Sherritt and Rich. Madole and were optioned by them to J. P. Gordon in October, 1925. Gordon then optioned the property now known as the Sherritt-Gordon to the Earle-Fasken interests who in the following few months completed 5,000 feet of diamond drilling in twenty-eight holes, from the results of which an ore-body of 450,000 tons was calculated to exist and to average 2.86 per cent copper, 3.3 per cent zinc. The option was dropped in September, 1926.

Finally, in the summer of 1927, E. L. Brown and R. J. Jowsey became interested in the deposit and were the means of bringing the property to development through Sherritt-Gordon Mines, Limited.

Following the incorporation of this company, July 5, 1927, prospecting became very active in the area and many claims were staked adjoining the Sherritt-Gordon holdings and on islands in Kississing lake for several miles to the west. Early in 1928 a mining recorder's office was established at Cold Lake settlement. During 1928 prospects with showings of copper-zinc sulphides were discovered in the vicinity of Elken and Walton lakes to the east and near Kipahigan lake towards the north-west corner of the area. In the late autumn, showings of iron and copper sulphides were located near Fay and Vamp lakes along the south boundary of the area.

Sherritt-Gordon Mine. — After Sherritt Gordon Mines, Limited, was organized in 1927, active development of the property was undertaken immediately. Extensive diamond drilling was followed by underground work in three localities. In 1929, a railroad was constructed by the Manitoba Northern Railway company from Cranberry Portage to the property, a distance of 42 miles. When the line was completed, mining and milling machinery and construction material for the various plants were freighted in and plant construction and mine development were pushed to prepare the property for production at a rate of 1,800 tons daily. Later, when the plants were nearing completion, it was decided, owing to the drastic decline in copper prices, to operate only one of the three grinding and milling units and the mine was brought into production at this reduced capacity in March, 1931.

In June, 1932, after operating continuously for over a year, the mine was closed down and all operations suspended owing

Power House Main Shaft Mill

Sherritt-Gordon Mine
Camp Lake, 1932

to further unprecedented declines in the price of copper. During its period of operation the mine produced 6,756 ounces of gold, 209,408 ounces of silver, and 24,647,569 pounds of copper.

According to Wright, the majority of the discoveries in the area are in a rectangle 10 miles wide and extending northwest and southeast for about 25 miles. He suggests that this may only mean that more detailed prospecting has been done in the small area surrounding the Sherritt-Gordon property than elsewhere.

Of these discoveries, mineralization is probably more widespread on the Smith-Pride property than on the others. Sphalerite is fairly abundant in one or two places and it may be that this property is deserving of further exploration. The country surrounding Walton lake and in the neighbourhood of the Douglas group would also seem to warrant further prospecting.

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GRANVILLE LAKE AREA

Granville lake, an expanded portion of Churchill river, lies 40 miles east of the Manitoba-Saskatchewan boundary and about 180 miles north of The Pas. It is approximately 150 miles distant by water route from Sherridon, the northern terminus of the Manitoba Northern railway. The journey by canoe takes from four to five days and the route, which commences at Cold Lake (Kississing) village one mile west of Sherridon, crosses Kississing lake and follows Kississing river to Flat Rock lake. It then crosses Flat Rock lake to Churchill river which is followed to Granville lake. There are twelve short portages on Kississing river with a total distance of 102 chains, and three portages on Churchill river.

The main prospecting area extends north from Granville lake to beyond Cockeram lake and then continues east to Barrington lake. The distance between Granville and Cockeram lakes is about 40 miles, and from Cockeram lake to Barrington lake about 25 miles. The area has been visited occasionally by prospectors during the last few years, more particularly during 1928 and 1929 when parties representing Nipissing Mining Company, Limited, and others explored parts of the Churchill River region. The Granville Lake area was geolog·cally mapped during 1932 and 1933 by G. W. H. Norman and J. F. Henderson of the Geological Survey of Canada.

Rocks of the Area

The rock groups of the area and their relationships resemble those of the region farther south which embraces Athapapuskow, Schist, Reed and Wekusko lakes, except that the basic volcanic group at Granville lake appears to have no interbedded sediments. Sediments do occur, however, as in the other areas and unconformably overlie the older lava.

The sediments are named the Sickle series, while the greenstone, or older volcanic group, is named the Pre-Sickle group.

The following table gives the relationship of the major rock groups:

TABLE OF FORMATIONS

Cenozoic	Glacial		Varved lake clays and silts; outwash sand and gravel deposits; eskers; morainic boulder ridges; boulder clay.
Precambrian		Post-Sickle granitic intrusives	Pegmatite and aplite. Granite. Diorite and quartz-oligoclase diorite. Granulose diorite, quartz diorite, granite, and quartz-feldspar porphyry.
			Diorite and gabbro.
		Sickle series	Arkose, greywacke, feldspathic quartzite; biotite gneiss, biotite-hornblende gneiss and granulite derived from the foregoing clastics; conglomerate; biotite gneiss derived from conglomerate.
			Unconformity
		Pre-Sickle group	Massive to schistose greenstone derived from andesite flows, agglomerate; breccia and tuff; with interbedded quartz porphyry, rhyolite, and trachyte flows (and related intrusive bodies grading into granite?), and iron formation; massive amphibolite hornblende schist and gneiss derived from the volcanics.

The greenstone or Pre-Sickle series occurs in belts between granite or between granite and sediments. The belts have a maximum width of about 4 miles and an average width of 2 to 3 miles. Their greater part consists of basic lavas, agglomerates, breccias, tuffs and intrusive bodies related to the lava. Acid volcanic rocks form only a small proportion of the Pre-Sickle group. The basic lavas are fine-grained massive green rocks; the acid lavas are fine-grained, whitish grey to pale green rocks, with or without small phenocrysts of quartz or quartz and feldspar.

The Sickle series, consisting of bedded quartzose-feldspathic sediments, lie in a synclinal structure with a sinuous trend and

extend southward from Sickle lake beyond Granville lake. Sills, dykes and stocks, ranging from diorite to gabbro, cut the Sickle rocks. Small dykes and intrusive masses of red, medium-grained granite with a granulose structure cut the greenstone on the west side of Hughes lake.

Mineral Occurrences

According to Norman:

"*The greenstone belts seem to present greater possibilities for the discovery of mineral deposits than other parts of the area.* The mineralization described in the southeast side of Barrington lake shows definitely that mineralization has occurred to some extent at least in the greenstone. Unfortunately in the northern part of the district where the greenstone belts are best developed, the country is low and the rocks are concealed over large areas by sand and gravel deposits, or by widely prevalent muskeg. The shores of the larger lakes are, however, usually burned, and rocky ridges in the country surrounding the lakes are visible.

"Quartz veins carrying sulphides, although too small to merit much attention, occur in the greenstone at a number of places, particularly where the greenstone is not highly altered. Indications of mineralization such as these were observed in the following localities: in the greenstone along the southern shores of Barrington lake; in the greenstone—here very highly sheared as is also the neighbouring granite to the north—that lies on the south side of the promontory extending eastward into Barrington lake; in the greenstone north of the large, irregular lake that drains south into Cockeram lake and lies 1 mile west of Hughes river; and in the greenstone west of Anson lake. Considering the very small part of the area actually observed and traversed this list is suggestive only, as many other localities probably present similar features. At each of these localities the greenstone is cut by sheared granite and by dykes of a grey, cherty rock or of grey, quartz-feldspar porphyry, which are impregnated by occasional sulphides.

"*The southern end of the greenstone belt that lies about 6 miles northeast of the north arm of Granville lake is worth mentioning on account of the structure here developed.* It is best reached by ascending the river, locally known as Lynx river, which empties into the north arm of Granville lake opposite Manitou island,

as far as the first large lake. A closely folded anticline that plunges to the south borders the eastern side of the lake and exposes a narrow wedge of greenstone and sheared quartz porphyry. The porphyry is in part intrusive and in part apparently a volcanic flow rock interbedded in the greenstone. A narrow syncline of sediments and conglomerate cut by diorite sills lies on the east side of the anticline. *These structures are worth examining to find out whether they have provided a structural control capable of localizing mineralization.* A narrow band of iron formation extends northwestward along the western border of the greenstone and must not be confused, if weathered, with the capping of an ore deposit. On the other hand, *mineralized quartz veins may cut the iron formation so that it should not necessarily be neglected.*

"To what extent mineralization in this district is associated with particular intrusive rocks or particular rock structure is not known. Indications of mineralization mentioned above occur in many cases in the greenstone where it is cut by sheared granite accompanied by grey, quartz-feldspar porphyry or grey, cherty dykes. On the other hand, the areas underlain by granite, mapped as massive and unsheared, are large; the granite boundaries of these areas with greenstone lie for the most part far from the main water routes and were not often visited. The suggested association of mineralization with the sheared granites rather than the unsheared granites remains to be tested before it can be established. The possibility, although quite hypothetical, that the Sickle conglomerate might act as a protection barrier capable of localizing mineralization is worth mentioning. This conglomerate is a massive, tough rock and has formed a strong, structural unit during the deformation of the rocks. *The contact of conglomerate with the older rocks east of Sickle lake and to the southeast of this lake, is a zone of weakness along which sills of diorite and granite have locally ascended.* Such zones of weakness may be mineralized if the rocks are highly sheared as at the Caribou mineral claim at Barrington lake. *Furthermore, a major fault dislocates the conglomerate south of Sickle lake and presents a structure worthy of investigation.*"

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REINDEER LAKE AREA

Reindeer lake lies on the boundary line between northern Saskatchewan and Manitoba, the greater part being on the Saskatchewan side. The portion in Manitoba lies between 57 degrees and 58 degrees north latitude and consists of Whitesand, Paskwachi and Brochet bays on the east side of the lake.

The nearest railway point to the area is Sherridon, from which it is reached by canoe across Kississing lake and northwesterly over a route which is partly unmapped, to Wapus river on Reindeer lake.

Rocks of the Area

Reindeer lake was geologically explored by C. H. Stockwell in 1927 and the only outcrops of sedimentary and volcanic rocks mapped by him in Manitoba lie in the area around Paskwachi bay and in a smaller area about 14 miles farther south in the vicinity of Whitesand river.

The sedimentary gneisses and schists of the area are similar to and may possibly be correlated with the Kisseynew sedimentary gneisses of the Kississing Lake area. They are injected by white pegmatitic granite and pegmatite, and by sill-like bands of amphibolite which are also cut in places by granitic and pegmatitic material. The Paskwachi Bay area is the northeastern part of the large area of sedimentary and igneous rocks that surrounds the south part of Reindeer lake in the Province of Saskatchewan.

Mineral Occurrences

The copper-zinc deposit at Paskwachi bay is a mineralized zone in a band of dark coarse-grained amphibolite which lies between grey gneisses. The zone has been traced for 800 feet by diamond drill and values in copper and zinc were found over widths varying from 1 foot to 23 feet. Zinc is more abundant than copper and lead; silver and gold occur in small amounts.

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RAT RIVER ROUTE FROM THREEPOINT LAKE TO SOUTHERN INDIAN LAKE, MANITOBA

Rat river is the canoe route which is regularly used by the Nelson House Indians who trap in the country surrounding Southern Indian lake. The route lies approximately along longitude 99 degrees, 15 minutes west. The latitude of the mouth of Rat river where it enters Threepoint lake is 55 degrees, 40 minutes, and that where the canoe route enters Southern Indian lake is 56 degrees, 40 minutes.

The nearest railway point is Thicket Portage, Mile 185, on the Hudson Bay railway. From Thicket Portage a canoe route follows through Wintering and Paint lakes to Ospwagan lake, whence Manasan river is descended to Burntwood river.

Rocks of the Area

The rocks exposed along Rat river consist of Precambrian granites and gneisses with one small area of an older complex of sediments and volcanics. Exposures are not numerous because the area is largely covered by deposits of Pleistocene clays.

The pre-granite complex consists of a series of sediments and volcanics exposed on the western shore of Karsakuwryamak lake, which is an expansion of Rat river about 30 miles southeast of Southern Indian lake. The belt of sediments and volcanics runs in a northeast direction and pinches out immediately north of the lake. The greatest width of the belt is about 5 miles. It is known to extend at least 6 miles west of the lake. The sedimentary part of the formation consists of finely banded gneisses and schists, and the igneous portion of dark volcanic flows and pyroclastics which are locally altered to hornblende schist and are intruded by light-coloured porphyry and dark-coloured lamprophyre dykes.

Quartz veins are present in this complex but none is known of sufficient size to be of importance.

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GRASS RIVER AREA

Grass river from Wekusko lake east to Paint lake and beyond to its junction with Nelson river near Split lake closely parallels the Hudson Bay railway. It expands at several places to form lakes, and the larger of these, Setting, Paint, and Partridge Crop, are easily reached from points on the railway.

The following lakes, which lie close to the river, are also for convenience included in the Grass River area: Wintering, which lies between Paint lake and the Hudson Bay railway to the south, the station of Thicket Portage being situated on the lake shore; and Landing lake, lying southeast of the railway at Thicket Portage.

Rocks of the Area

In the Grass River area the older volcanic and sedimentary schists and gneisses are limited to small areas within the granite. Bedded quartzite and greywacke outcrop along the west shore of Setting lake for a distance of about 17 miles. North of the mouth of Setting creek the sediments are at least 2 miles wide.

At Wintering lake the rocks about the lake, in order of age from youngest to oldest, are, according to Wright, as follows: olivine diabase; granite, aplite, pegmatite; pyroxenite and gabbro; grey granite and syenite gneiss; and quartz-mica-garnet sedimentary gneiss.

The granitic gneisses are grey to black and contain small inclusions of garnet-rich sedimentary gneiss and of black chloritic schist. The pyroxenite cuts the complex of sedimentary and intrusive gneisses.

In the Partridge Crop Lake area grey quartzose and micaceous gneisses outcrop as small areas within granite-gneiss and granite. Both the igneous and sedimentary gneisses are penetrated by dykes and small, boss-shaped masses of pyroxenite and quartz diorite, and the gneisses and basic intrusives are cut by dykes of pink and white, medium-grained granite and pegmatite.

Mineral Occurrences

During the period, 1927 to 1929, a number of claims were staked at Setting, Wintering and Partridge Crop lakes. In 1929 a sulphide deposit was diamond drilled on an island near

the east shore of Wintering lake along the contact between pyroxenite and granitic gneisses.

The sulphide-bearing zone and pyroxenite are cut by pegmatite. Pyrrhotite and chalcopyrite appear to be localized in small areas near these pegmatites.

A second sulphide deposit of a similar nature occurs on a point on the northwest shore of the lake about 2 miles southwest of the outlet and was prospected during 1928. Chalcopyrite and pyrrhotite occur in small bodies within or near pyroxenite cut by pegmatite. Magnetite is very abundant in some zones in the pyroxenite.

In 1928 and 1929 a copper-nickel deposit on the lake about 8 miles north of Mile 205, Hudson Bay railway, was explored.

Some galena and lesser amounts of sphalerite and chalcopyrite occur in the quartzite beds in this area.

REFERENCE

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OSPWAGAN LAKE AREA

Ospwagan lake lies in the valley of Burntwood river immediately north of Paint lake and is reached by canoe from Thicket Portage, Mile 185, on the Hudson Bay railway. The route crosses Wintering and Paint lakes and includes in order five portages of the following lengths: 53 chains; 1 mile and 13 chains; 8 chains; 1 mile and 10 chains; and 30 chains. The first three are between Wintering and Paint lakes and the last two are between Paint and Ospwagan lakes.

Ospwagan Lake area was geologically mapped in 1920 by F. J. Alcock. The rocks of the area are all of Precambrian age and consist of a belt of greenstone and tuffaceous rocks forming a narrow fringe on either side of Ospwagan and Little Pipe lakes and extending northeastward to Burntwood river. These greenstone rocks have been to a large extent altered by granite intrusion into hornblende schists. According to Alcock the greenstone belt is narrow.

Some claims were staked several years ago in this area in small quartz veins in greenstone.

REFERENCE

Alcock, F. J.:
"Ospwagan Lake-Burntwood River Area, Northern Manitoba;" Geol. Surv., Canada, Sum. Rept. 1920, pt. C, pp.1-6.

MYSTERY LAKE AREA

Mystery lake lies about 17 miles northeast of Ospwagan lake from which it is easily reached by descending Manasan river a distance of about 8 miles to Burntwood river, and then descending Burntwood river a distance of 9 miles to its junction with a stream that flows into it from the north. This stream is ascended 2 miles to Mystery lake which is about 5 miles long and averages a mile in width to near the north end where two bays extend east and west from the main body of the lake.

Rocks of the Area

Lavas and sediments outcrop along the west shore of the lake while granite, containing many inclusions of sediments and volcanics, outcrops on the north and east shores. Later dykes of gabbro and diabase cut the older lavas, sediments and granitic rocks.

Mineral Occurrences

In 1927, a deposit of silver-bearing galena was discovered and staked by Gordon Murray on the west shore of the lake about 2 miles north of the outlet. The deposit occurs in schistose andesite adjoining a grey silicious rock which may consist of recrystallized quartzose sediments injected with granitic material.

The schist zone varies from 2½ to 20 feet in width and galena and sphalerite occur in small lenses of calcite and quartz along the schist zone for at least 450 feet. The zone of schist narrows to the north and passes under the lake to the south. The galena-bearing veins rarely exceed one foot in width or 100 feet in length although one vein containing lenses and pockets of galena is 2 feet wide.

REFERENCES

Wright, J. F.:
"Geology and Mineral Deposits of a Part of Northwest Manitoba;" Geol. Surv., Canada, Sum. Rept. 1930, pt. C, pp. 117-118.

SEAL RIVER AREA

Seal river rises east of the north end of Reindeer lake and flows northeast for approximately 200 miles to enter Hudson bay about 30 miles north of Churchill. The area may be reached by air from Ilford on the Hudson Bay railway or by canoe from Sherridon, Wabowden and Thicket Portage. The eastern section may be reached by canoe from Churchill, but travel upstream on Seal river is difficult as the rise from the coast in 110 miles upstream is 820 feet and rapids are numerous.

Much of the area is drift covered but in the vicinity of Great island, the most promising prospecting locality, rock outcrops and ridges are fairly numerous.

All of the area is underlain by Precambrian rocks. Highly folded sediments composed of beds of quartzite, mica-schist and conglomerate occur around and to the west of Shethanei lake. The strike of these sediments is irregular and the beds dip steeply. The sediments are cut by large, irregular masses, dykes and sills of granitic rocks and numerous associated pegmatite bodies.

In the vicinity of Great island, the rocks consist of a series of highly folded and metamorphosed volcanic rocks made up of rhyolite, andesite and basalt, together with tuffs and agglomerates. These are overlain unconformably by sedimentary rocks, chiefly slates and quartzites. The sediments are folded along axes which strike north of east and plunge east usually at low angles. Folding is in places close but in others open and broad. Granitic rocks and dykes of quartz and feldspar porphyry intrude the volcanics. Areas of volcanic rocks occur for some distance eastward down the river.

The most promising prospecting ground in the area would appear to be in the vicinity of Great island and the country bordering the river channel east to Hudson bay.

REFERENCES

Johnston, A. W.:
"Preliminary Report on a Geological Exploration of Seal River, Manitoba;" Bureau of Economic Geology, Dept. of Mines, Canada, Paper 35-2, 1936.

POSTSCRIPT

The Province of Manitoba is relatively young in the mining industry, yet the growth of the industry has been steady and sound.

The first metallic production recorded for the Province was in 1917 when the value reached $318,287 made up of gold, silver and copper.

The year 1935 was the best in Manitoba's mining history when metallic production was valued at $10,609,841. Gold, silver, copper, zinc, cadmium, lead, selenium and tellurium were extracted from Manitoba ores. The greater part of the production has been obtained from the Flin Flon mine but gold mines at Wadhope, Bissett, Island Lake and Gods Lake have made a considerable contribution to the gold and silver.

The Precambrian areas of Manitoba offer much that is attractive to the prospector whether for base or precious metals.

The Mines Branch of the Department of Mines and Natural Resources has a complete service bureau for prospectors, and assists in many ways in promoting the mining interests of the Province. Free assays to prospectors are done at the laboratory in Winnipeg. Prospectors' classes are held in mining communities at convenient times to give instruction in elementary geology and mineralogy, together with the spotting of minerals.

Geological reports and maps are available at the Mining Recorders' offices. Inquiries directed to the Mines Branch, Department of Mines and Natural Resources, Winnipeg, will be given prompt attention.

PART IV

GLOSSARY

A

Acid rock—Usually a light-coloured rock high in silica, soda and potash, e.g. granites, rhyolites, etc.

agglomerate—A fragmental volcanic rock.

aikinite—Lead-copper-bismuth sulphide. Soft, steel-grey mineral, easily fusible. Occurs massive and in long prismatic crystals resembling jamesonite.

albite—Sodium aluminum silicate. One of a series of minerals known as feldspars, found in acid rocks and some vein deposits.

amblygonite—A phosphate of lithium and aluminium. Massive and crystalline occurring in pegmatite dykes. Colour is usually white to pale green or blue. *Do not confuse with albite.*

amphibole—Group name of a series of minerals whose chief rock-forming member is hornblende.

andesine—A feldspar mineral, intermediate in composition between sodium-aluminium silicate and lime-aluminium silicate. Common in andesite and diorite.

andesite—Fine-grained volcanic rock intermediate in composition between acid and basic; usually green or dark grey in colour. Common constituent of "greenstone" formations.

ankerite—A carbonate of iron, calcium and magnesium. A common gangue mineral occurring in veins with quartz, etc. Weathers, giving rusty streaks in quartz. *Do not confuse with weathered sulphide.*

anorthite—Calcium-aluminium silicate. A basic member of the plagioclase series of feldspar minerals.

anticline—A folded rock structure with strata dipping away from a central axis.

apatite—A calcium-phosphate mineral, containing chlorine or fluorine. Found in large crystals in some pegmatite dykes.

aplite—Rock term applied to fine- to medium-grained dyke rocks composed of acid feldspar and quartz. Usually light-coloured with a sugary texture.

arkose—A sedimentary rock composed principally of quartz and feldspar fragments.

arsenopyrite (mispickel)—Iron-arsenic sulphide. A steel-gray sulphide mineral. A refractory mineral occurring with many gold ores.

augite—A complex iron-magnesium-calcium-aluminium silicate. A common mineral in basic igneous rocks, especially basalts and gabbros.

B

Basalt—A dark-coloured volcanic rock. Andesite and basalt are spoken of as "greenstones" by the prospector.

basic rock—A term applied to dark-coloured igneous rocks that are low in silica, e.g. basalt, gabbro, peridotite, etc.

batholith—A term applied to large irregular masses of intrusive igneous rock that have solidified at depth and have later been exposed by erosion. Usually granitic in composition.

beryl—A beryllium-aluminium silicate mineral. White to tints of green in colour. Occurs in pegmatite dykes. Harder than quartz and usually found in six-sided crystals.

biotite—A magnesium-iron mica. Black to dark brown. Occurs in igneous and metamorphic rocks.

bleb—A small discontinuous occurrence of a mineral within a larger mass of other mineral or rock, e.g. blebs of quartz in solid sulphides.

boss—An occurrence of igneous rock of more or less circular outline and restricted areal extent with steeply-dipping contacts with the enclosing rocks.

breccia—A rock composed of angular fragments of a similar or differing composition that have been compacted or cemented together.

C

Calcareous—Term applied to rocks or mineral containing abundant lime.

calcite—Calcium carbonate. The chief constituent of limestone and a minor constituent of other sedimentary rocks. Also occurring abundantly as a gangue mineral in veins.

carbonates—A mineral group containing the acid radical CO_3. This group of minerals usually effervesces upon the application of warm hydrochloric acid. (See calcite.)

cassiterite—Tin oxide. Occurs as dark brown granular crystals in pegmatite dykes in Manitoba. Tin ore is associated with a rock type known as greisen.

chalcocite—Copper sulphide. Soft grey-black ore mineral of copper. Rare in this province.

chalcopyrite—Copper-iron sulphide. Chief ore mineral of copper. Commonly associated with gold in quartz veins.

chalmersite (cubanite)—Copper-iron sulphide. An uncommon ore mineral of copper.

channel-sample—A sample of uniform width and depth cut across a mineral occurrence.

chert—An extremely fine-grained sedimentary rock composed largely of silica.

chlorite—A green micaceous mineral of variable composition occurring as the main constituent of greenstone schists.

cleavlandite—A lamellar variety of albite.

competency—The ability of a rock to resist forces of deformation.

conglomerate—A sedimentary rock composed of rounded water-worn fragments.

contact-metamorphic—A term referring to the alteration produced at the contact of an igneous rock with an older formation.

cuprite—Copper oxide. A red oxide of copper formed in the oxidized zone of ore deposits.

D

Dendritic—Branching or branch-like.

diabase—A dark-coloured dyke rock containing labradorite feldspar enclosed within augite crystals as the principal constituents.

diorite—Rock name for a medium- to coarse-grained igneous rock made up of hornblende and andesine feldspar. Occurs as small intrusive masses as compared to granite.

disseminated—Scattered or diffused through.

dolomite—Calcium-magnesium carbonate. Also a rock term denoting one composed essentially of the mineral dolomite.

drift—A horizontal passage underground following the vein.

dyke—Tabular-shaped, intrusive, igneous rock mass which crosses structural planes of older rock. (Contrast with sill).

E

Epidote—A green mineral containing calcium, iron, aluminium, and silica. Usually indicates some degree of rock alteration.

erosion—The process by which land areas are reduced to base-level by the agencies of water, air and ice.

esker—A narrow sinuous ridge of glacial debris deposited by a sub-glacial stream.

extrusive—Solidified on the surface of the earth, e.g. lava flow. Refers to igneous rocks.

F

Fault—A break in the continuity of a body of rock attended by movement of one part of the rock-mass relative to another.

flow—Term referring to the extrusive nature of volcanic rocks.

fluorite—Calcium fluoride. A colourless, green-blue or purple mineral. In Manitoba occurs in pegmatites.

foliation—The banded or sheet-like structure of metamorphic rocks as distinguished from the stratification or bedding-planes of sediments.

foot-wall—The wall of rock underlying a vein.

free-milling—A term applied to gold and silver ores in which gold can be recovered by crushing and amalgamation without use of chemicals or roasting. A portion of gold in an ore may be termed "free-milling."

fuchsite—A chromium-bearing mica. Green in colour.

G

Gabbro—A medium- to coarse-grained igneous rock composed mainly of labradorite feldspar, pyroxene and/or olivine. Magnetite, ilmenite and apatite also occur as accessory minerals.

galena—Lead sulphide. Chief ore of lead, commonly contains values in silver.

gangue—The valueless constituents in an ore-body or vein.

garnet—A complex silicate of calcium, iron, aluminium, etc. Common in many forms of metamorphic rock. Usually has well-developed crystal form. Color red, brown or black.

genetic—relating to the origin of a rock type.

gneiss—A crystalline igneous or metamorphic rock possessing a parallelism of mineral arrangement but lacking the easy cleavage of schist.

gossan—The rusty weathered outcrop formed by the surface oxidation of a sulphide deposit.

grab sample—A sample of ore taken at random.

granite—A coarse- to medium-grained igneous rock, composed principally of quartz, orthoclase and acid plagioclase feldspar, with accessory minerals such as biotite, muscovite, hornblende, etc.

granodiorite—A coarse- to medium-grained rock, intermediate in composition between a granite and a quartz diorite.

greenstone—A general term applied to altered rocks such as andesites, basalts, etc., which have developed enough chlorite to give them a green cast.

greisen—A rock composed essentially of muscovite and quartz. Usually formed by the hydrothermal alteration of a granite.

grit—A sandstone composed of coarse angular grains and very small pebbles.

gypsum—Hydrous calcium sulphate. A soft mineral sometimes occurring in the oxidized zone of ore deposits, also as a component mineral in sedimentary beds.

H

Hanging-wall—The wall of rock overlying a vein.

hornblende—A complex iron, magnesium, calcium, aluminium silicate. Common mineral in igneous rocks, especially andesites and diorites. Alters to form chlorite.

hydrothermal—A term applied to that type of alteration produced by the action of hot mineralized waters.

I

Igneous—Referring to rocks solidified from a molten state, in contrast to sedimentary and metamorphic rocks.

ilmenite—Iron-titanium oxide. A dark, granular mineral resembling magnetite occurring as an accessory mineral in igneous rocks or in magmatic segregations.

inclusion—A rock fragment of variable size inclosed in an igneous rock; a xenolith.

intrusive—Referring to rocks that have been introduced into older formations and which have solidified below the surface.

iron formation—Beds of sedimentary rock containing a high percentage of iron oxide as hematite or magnetite.

J

Joint—A plane or gently curved crack or fissure in a rock, with no displacement as in a fault.

K

Keewatin—Period name of early Precambrian rocks, commonly applied to lowest members of a greenstone series in the Precambrian.

L

Labradorite—Calcium-sodium-aluminium silicate. A basic member of the feldspar series.

laccolith—A mass of intrusive igneous rock which has domed overlying rocks and possesses a floor of older rocks.

lamellar—A sheeted or platey structure.

lamprophyre—A dark sugary-textured fine- to medium-grained dyke rock, basic in composition and commonly porphyritic.

lava—Igneous rock that has been extruded on to the earth surface.

lepidolite—Lithium-aluminium silicate. A lilac-coloured micaceous mineral occurring in some pegmatite dykes.

limonite—Hydrous iron oxide. A rusty coloured mineral commonly occurring in the "gossan" or weathered outcropping of an ore deposit.

lithological—Pertaining to the science of rocks.

M

Magma—Molten rock material.

magmatic segregation—A process by which certain types of ore deposit are supposed to form, due to a separation of magmatic constituents into fractional parts.

magnetite—Magnetic iron oxide. A black granular mineral. Occurs as an accessory mineral in most igneous rocks and in large deposits as the principal mineral.

metamorphic—Changed or altered. Chief agents of metamorphism in rocks are heat and pressure.

microcline—A variety of acid feldspar. Common in granite and granite pegmatites.

molybdenite—Molybdenum sulphide. A soft foliated mineral like mica, possessing a metallic lustre.

monazite—Phosphate of the cerium metals. Thorium content gives mineral its value. Found in pegmatite dykes.

moraine—An accumulation of rock flour and boulders deposited by a glacier.

muscovite—Potash-bearing white mica. Common in igneous rocks.

N

Norite—A variety of gabbro possessing a particular variety of pyroxene. A microscopic distinction.

O

Oligoclase—Sodium-calcium-aluminium silicate. A member of the feldspar series with slightly more lime than albite.

olivine—Magnesium-iron silicate. A green, granular mineral found associated with basic rocks.

orthoclase—Potassium-aluminium silicate. An acid feldspar dominant in granites.

P

Pegmatite—An extremely coarse-grained variety of igneous rock mostly granitic in composition. Occurs as dykes frequently bearing rare-element minerals.

peneplain—The lowest level to which erosion can reduce a land surface.

pentlandite—A sulphide of iron and nickel. A bronze, brittle mineral usually associated with pyrrhotite.

peridotite—An intrusive rock composed mostly of basic feldspar (labradorite) and olivine. Deposits of copper, nickel, platinum, chromium and asbestos are associated with this type of rock.

phenocryst—A large crystal in a rock surrounded by a matrix of crystals of smaller grain size.

pillow lava—Volcanic rocks possessing the rounded outline of early cooled portions of the flow incorporated in the rock mass.

plagioclase—The group name applied to a series of soda-lime-aluminium silicates known as feldspars. Common constituents of igneous rocks.

porphyry—An igneous rock in which two distinct ranges of crystal size have been developed. Not necessarily but usually fine-grained in part.

Precambrian—A broad term denoting the age of rocks formed before the Cambrian period.

pyrite—Iron sulphide. A brassy yellow sulphide associated with many types of ore. Frequently intimately associated with gold.

pyroclastic—Refers to rocks containing fragments of volcanic rocks which have been ejected from volcanic vents as bombs or ash, etc. Tuffs and agglomerates.

pyroxene—Calcium-magnesium-iron silicate. A dark silicate mineral series associated with basic rocks. Augite is the common member of the series.

pyrrhotite—Magnetic sulphide of iron. A bronze-coloured sulphide mineral which is associated with many types of ore.

Q

Quartz—Oxide of silicon. A vitreous mineral, hard and without cleavage. Most common gangue mineral associated with ore deposits.

quartzite—A metamorphic rock produced by the recrystallization of quartz grains in a sandstone.

quartz porphyry—A general term used to denote a fine-grained, light-coloured dyke rock possessing quartz phenocrysts or "eyes."

R

Rhyolite—Fine-grained equivalent of a granite, possessing the same minerals as that rock.

S

Scheelite—Calcium tungstate. A light-coloured mineral having a high specific gravity, usually associated with high temperature deposits, veins and pegmatite dykes.

sedimentary—Formed by deposition in water or air.

sericite—A variety of muscovite occurring as small scales in schists.

serpentine—A hydrous magnesium silicate. A green mineral resulting from the alteration of olivine, amphibole or pyroxene.

siderite—Iron carbonate. A pale yellow to dark brown, cleavable mineral. Occurs as a gangue in many types of deposit.

silicified—Said of rock which has been impregnated with secondary, or introduced quartz.

sill—An igneous rock structure formed by the cooling of magma between bedding-planes of sediments.

sinuous—Twisting, winding.

slate—A cleavable metamorphic rock produced by recrystallization of shale.

slickenside—A polished grooved surface on a rock or vein wall formed by movement between rock masses.

sphalerite—Zinc sulphide. A pale to dark brown, cleavable mineral, occurring in many gold quartz veins and sulphide bodies in Manitoba. Sometimes called resin-jack or black-jack.

sphene—Calcium-titanium silicate. Occurs as an accessory mineral in igneous rocks. Also known as titanite.

spodumene—Lithium-aluminium silicate. A white, platey mineral with vitreous lustre. Occurs as large crystals in some pegmatite dykes.

sporadic—Irregularly occurring.

stock—An igneous mass of circular or elliptical plan outline, intrusive into older formations.

stockwork—A rock mass made up of numerous interpenetrating veinlets usually mineralized.

stratum (pl. strata)—A bed or layer of rock.

striated—Grooved or marked by a series of parallel scratches.

syenite—A coarse- to medium-grained igneous rock, composed essentially of acid feldspar and hornblende or biotite without quartz.

syncline—A folded rock structure with strata dipping towards a central axis.

T

Talc—Hydrous magnesium silicate. A soft soapy mineral occurring in schists and other metamorphic rocks.

tantalite-columbite—A tantalate and columbate of iron and manganese. A brownish-black mineral of high specific gravity possessing a fair cleavage. Found in bladed aggregates in pegmatite dykes.

telluride—A compound of tellurium with another element—gold, silver, lead, etc.

tetrahedrite (grey copper ore)—Copper-antimony sulphide. A massive grey-black mineral without cleavage; frequently carries values in silver.

topaz—Silicate of aluminium and fluorine. A hard, transparent mineral of variable colour, has excellent cleavage. Found associated with acid rocks—granite, rhyolite, and pegmatites.

tourmaline—A complex silicate of boron and aluminium. Mineral occurs as long slender, dark, glassy crystals, striated parallel to long axis with triangular cross-section. Found in pegmatites and contact schists and gneisses.

trachyte—Fine-grained volcanic equivalent of a syenite.

triphylite—Phosphate of iron, manganese and lithium. A glassy, grayish-blue mineral possessing a good cleavage. Associated with pegmatite minerals.

tuff—A fine-grained sedimentary rock composed principally of volcanic ash.

twinned-crystals—Crystals in which one or more parts, regularly arranged are set at fixed angles to other parts of the same crystal.

V

Varve—Variation in size of grain in the lamination of a sedimentary bed, due to seasonal changes of deposition.

vein—A more or less tabular-shaped or sheet-like mineral mass, usually composed of both ore and gangue minerals.

volcanic—Derived from volcanoes.

W

Waste-horse—A fragment of barren rock included within a vein or ore-body.

Z

Zinnwaldite—Iron-lithium mica. A pale lilac to yellow-grey mineral. Occurs in pegmatite dykes.

Note.—For a complete description of the minerals referred to in this glossary, the reader should consult a standard text on mineralogy.

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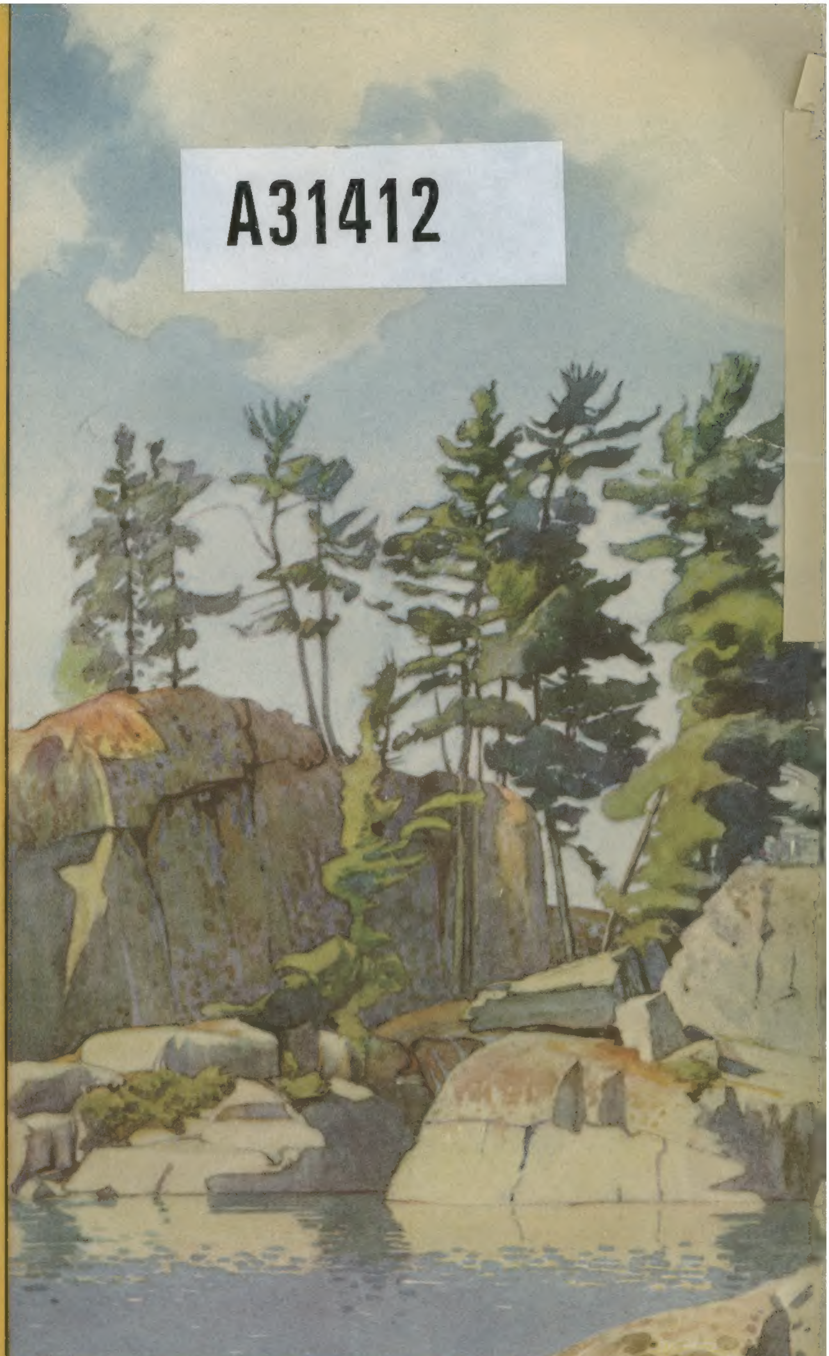

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